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Chapter 9. Research, Evaluation, and Experimentation

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Chapter 9. Research, Evaluation, and Experimentation

INTRODUCTION

Starting with the 1950 Census of Population and Housing, the Census Bureau has followed a policy of carrying out a careful evaluation of each census's accuracy in terms of coverage, content, and procedures, together with research and experimentation.

In the 1950 and subsequent censuses, population coverage was evaluated through a post-enumeration survey (PES) and demographic analysis. Content evaluation for 1950 applied two basic methodologies—reenumeration and record checks—that continued to be utilized and developed in later years. Procedures were subjected to studies of data-collection methodology and enumerator variance, experiments with self-enumeration, and a test of a separate questionnaire for each household as an alternative to the 1950 census "line" schedule, which listed 30 persons and 12 dwelling units. The 1950 evaluation program led to increased use of self-enumeration and sampling in the 1960 census, as well as wording changes in some of the questions.

For 1960, a match between the census and the Current Population Survey (CPS) produced indexes of inconsistency for various labor-force and income characteristics, and a sample of 5,000 census-sample households was reinterviewed in order to estimate simple response variance and response bias. The staff studied the effects of dependent vs. independent reconciliation, and carried out two major record checks to evaluate respondent reports on income, and occupation and industry. There were several analyses of sources of error in census data caused by enumerator and crew leader biases, response variance, coder variance, and violation of processing rules. Prior to and during the census, there also were coverage improvement studies in selected areas, in which postal carriers reported any missed or duplicated households on their routes. Most study results led to further expansion of self-enumeration and to improvement in processing procedures for the 1970 census.

There were three major reenumeration studies of content errors in the 1970 census. One, covering about 11,000 housing units, emphasized items included in the census for the first time (some of which were subjected to a three-way match to administrative records as well), and led to estimates of simple response variance for selected characteristics. In a second study, a sample of 40,000 households was reinterviewed to estimate response bias in the census question on disability. The third study was another CPS-census match to determine response

differences between the March 1970 CPS and the census. Content error was evaluated through record checks and reporting error through examination of the responses to such items as employment 5 years ago, value of home, and place of work. Procedural evaluations and tests in the 1970 census analyzed enumerator coding, sample control, distortions in sample size, special coverage-improvement procedures, field quality control, and geographic coding. Finally, mail procedures were tried in "conventional" district offices (i.e., those using the traditional door-to-door enumeration method) to see whether it was feasible and appropriate to expand the mail census further into these areas in 1980. These evaluations identified problems with content, questionnaire design, data collection, and processing procedures that were addressed in planning the 1980 census. The mail extension test and the studies of correlated response error encouraged the expansion of the mail census from 65 percent of the population in 1970 to 95 percent in 1980.

The 1980 census had a research, evaluation, and experimental (REX) program consisting of over 40 separate projects that could be categorized in terms of their objectives as follows:

- **Coverage evaluation and coverage measurement procedures**—By far the largest group of projects, this category included the major coverage measurement studies. Population coverage was estimated through the post-enumeration program (PEP), administrative-record matching, and demographic analysis. Housing coverage, including estimates of overenumeration, was the topic of three studies, while the forward- and retrospective-trace studies and the IRS [Internal Revenue Service]/census match dealt with alternative population-coverage measurement procedures.
- **Experimental program**—The research efforts in this category included tests of alternative data-collection methods and ways to recruit, train, and maintain the temporary work force.
- **Coverage-improvement evaluations**—The studies in this category evaluated the cost, results, and field procedures for various components of the 1980 census coverage-improvement program.
- **Processing and quality-control evaluations**—A number of evaluations to study various aspects of the data capture and processing system were included in this category. The staff was particularly interested in the effectiveness of quality-control operations on the census program.

- **Content evaluations**—These investigated the validity of the responses to various census questions, such as utility costs and education.
- **“Other” studies**—Two studies in this category, one of the components of variance and the other of total error, were designed to estimate nonsampling errors in the census data. The other evaluations addressed the effect of the publicity program and respondents’ behavior regarding the census questionnaire.

These projects are described in the sections that follow. Much of the information in this chapter is taken from preliminary evaluation results memorandums (PERM’s), which were Census Bureau staff members’ internal-use documents. Their conclusions did not necessarily represent official Census Bureau statements. Relevant PERM numbers appear in the text; appendix 9A contains a complete numerical list. Further references appear in the bibliography at the end of the chapter.

A number of the REX studies were designed purposely to be carried out during, rather than after, the census. This would allow researchers to examine procedures and data at various stages of completeness or to conduct experiments side by side with standard census activities and use the latter as controls. These optimal conditions could not always be met, so that a number of the REX projects had procedural and/or timing problems, or could not be finished. In other cases, both during and after the census, the data were insufficient or inconclusive. Some of the results were tentative in nature. In a few instances, the studies were not completed. Thus, any REX project conclusions reported below should be used with caution.

COVERAGE EVALUATION AND MEASUREMENT PROCEDURES

Introduction

Measuring and evaluating census coverage involved surveys and studies after the enumeration had been completed. These activities, which are described below, included independent estimates, a set of studies dealing with housing units and their occupants, and matches of census records with other data bases.

Post-Census Coverage Evaluation Program

This portion of the program developed independent checks of the coverage of population and housing units in the 1980 census. There were two main procedures used to estimate population undercount:

Demographic analysis was used to construct estimates of the total U.S. population and its components by race, age, and sex from aggregate statistics on births, deaths, immigration, emigration, past censuses, Medicare enrollment, and other sources.

The 1980 Post-Enumeration Program (PEP) employed sample-survey methods to measure directly the distinct components of census coverage error, and by this means to estimate the net coverage error for the census.

Demographic analysis—For over 40 years the Census Bureau has used methods of demographic analysis, widely utilized by demographers to develop population estimates and projections as well as estimates of census coverage. As a tool for census evaluation, demographic analysis involves first developing estimates for the population in various categories, such as age-sex-race groups, at the census date by combining various types of demographic data. The estimated values then are compared with the corresponding census counts to yield a measure of net census coverage:

Census coverage = rate	Census count	divided by	Demographic estimate (or estimated population)
and			
Census undercount = rate	1.0	minus	Census coverage rate

Demographic analysis’ foundations are the logical consistency and interrelationships of the underlying demographic variables and the data used to measure them. These data, drawn from sources essentially independent of the census, include: Birth, death, and immigration statistics; expected sex ratios, life tables, etc.; historical series of census data; and data from sample surveys. The data are corrected for various types of errors and, as such, are assumed to be more accurate than the census being evaluated. The method’s overall accuracy depends on the quality of the demographic data and the corrections.

The particular procedure used to estimate coverage nationally for the various subgroups in the 1980 census depended primarily on the nature and availability of the required demographic data. In brief, the principal estimates were derived as follows:

1. Estimates of the population under age 45 in 1980 for both sexes and each race category (White, Black, and other) were based directly on births from 1935 to 1980, corrected for underregistration. The adjusted births were carried forward to later census dates with statistics and estimates of deaths, immigration, and emigration (i.e., components

of change) using a basic demographic accounting relationship, namely, population equals births minus deaths plus in-migrants minus out-migrants.

2. Estimates of the White population aged 45 to 64 years in 1980 were based on revisions of estimates of total White births derived from 1915 to 1935. The estimates were carried forward to 1940 with life-table survival rates and to subsequent census dates with components of change as used for ages under 45 in 1980.
3. Estimates of the Black population aged 45 to 64 years in 1980 were based on estimates for this cohort in 1960 (i.e., when it was 25 to 44 years of age). The estimates for females aged 25 to 44 years in 1960 were derived principally through techniques of stable population analysis; the estimates for males in 1960 were based on expected sex ratios. The estimates for both males and females were carried forward to 1970 and 1980 and backward in time to previous census dates with components of change.
4. Estimates of the other-races population for females aged 45 to 64 years in 1980 were derived from assumptions about the consistency of age patterns of coverage in the 1950 to 1980 censuses for this cohort. The estimates for other-races males in 1980 were developed from expected sex ratios. The estimates for 1980 were carried backward in time to previous census dates with components of change.
5. Estimates of the population aged 65 years and over in 1980 for both sexes and all race groups were developed from aggregate Medicare enrollments, adjusted for underenrollment. The estimates for 1980 were carried backward in time to previous census dates with components of change.

Compared with estimates previously published for other censuses, the 1980 demographic analysis caused a number of revisions, some in opposite or offsetting directions. Most of the retrospective revisions from 1980 were small, but the rather large revision attributable to reestimating White births for 1915-1935 was almost completely offset by new estimates of emigration for 1950-1970. The revised undercount rates for earlier censuses tended to be higher than those published previously. The 1980 census appeared to represent a substantial improvement in coverage over past censuses. Furthermore, the revisions had almost no effect on relative differences in coverage (by age, sex, or race).

Interpretation of results—Demographic analysis offers an estimate of the population from which the census count can be subtracted to arrive at measures of the amount of census undercount (or overcount). For certain reasons, however, the differences between the estimated resident population based on demographic analysis and the published census counts cannot be interpreted directly as census undercounts (or overcounts). For the differences to represent net undercounts

directly, the two populations (the census and the demographic estimate) would have to be defined alike. Two major problems affected the comparisons for 1980—changes from the past in the reporting and coding of racial groups in the 1980 census, and the presence of uncertain numbers of undocumented aliens in the country (and in the census counts) in 1980.

In the 1980 census, changes in the practice of reporting race, particularly on the part of the Hispanic population, and in coding and classifying racial groups created a major inconsistency between the 1980 census data and historical data series, including censuses, vital statistics, and immigration records. Thus, it was not possible to compare the demographic estimates for the principal racial groups (White, Black, and other) with the published census figures to derive meaningful coverage estimates. About 40 percent of the Hispanic population counted in 1980, or over 5.8 million persons, did not choose one of the specified races listed on the census questionnaire, but chose the "Other" category instead. Such persons who also wrote in a national-origin designation that indicated an Hispanic-origin group remained in the "Other races" category in the published 1980 census data, whereas in previous censuses and in vital statistics, such responses were almost always coded into the "White" category.

In another change in the 1980 census, "Asian Indian" was added as a separate response category to the race questions and included in the "Asian and Pacific Islander" grouping or the "Other races" category in the 1980 census tabulations. However, in past censuses and in vital statistics through 1978, persons of Asian Indian descent were classified as "White." This group was estimated to have grown from fewer than 100,000 in 1970 to about 362,000 in 1980. To attain comparability between the 1980 census racial groups and the populations estimated through demographic analysis, the 1980 race data were reassigned to conform with the historical categories of the estimates as either White, Black, or other. (All of these computations were carried out within race, origin, sex, and age categories at the county level and aggregated to the national level.) This modification for 1980 added 6.3 million persons (3.4 percent) to the White category and 188,000 persons (0.7 percent) to the Black population. The "Other races" category was decreased by 6.5 million (55.9 percent). Because most of the reclassification involved Whites and persons of other races, these two categories often were combined in presenting the evaluation results. In an attempt to overcome the problem relating to measuring the number of undocumented immigrants, the staff adopted two strategies. The first approach involved modifying the census counts to make them comparable with the demographic estimate: Estimates of undocumented immigrants counted in the 1980 census were subtracted from the census figures by age, sex, and race. This led to an estimated census count of legal residents that could be compared with the demographic estimate of the same group and thus produce an estimate of its census undercount. The final percentage estimates of the legally resident population's

net undercount, based on demographic analysis, by sex and race, for 1980 and 1970 were as follows:

Sex and race	1980	1970
Total population	1.0	2.6
Male	2.0	3.3
Female	—	1.8
Black	5.6	7.7
White and other races	0.3	1.9
Difference		
Male:female	2.0	1.5
Black:White and other races	5.3	5.8

The second approach dealt with the issue of undocumented immigrants by adding an estimate of the total number of undocumented immigrants residing in the country in 1980 to the demographic estimate of the legally resident population. The difference between the augmented demographic estimate and the census then represented the undercount of the total resident population. The number of undocumented immigrants added ranged from 2.06 million (the estimated number of undocumented aliens counted in the 1980 census) to 5 million.

Because the range of estimates of the undocumented immigrant population was much larger than the ranges for other components in the demographic estimates, this second approach ultimately led to a range of undercount estimates rather than a single one.

The final alternative estimates of percent net undercount of the total population for 1980, based on demographic analysis and various assumed numbers of undocumented immigrants, were as follows:

Sex and race	Undocumented residents (millions)			
	2.06	3	4	5
Total population	1.0	1.4	1.8	2.2 (per-cent)
Male	1.9	2.4	2.8	3.3
Female	—	0.4	0.8	1.2
Black	5.6	5.9	6.2	6.5
White and other races	0.3	0.7	1.2	1.6
Difference				
Male:female	1.9	2.0	2.0	2.1
Black:White and other races	5.3	5.2	5.0	4.9

Although the incremental increases in the assumed number of undocumented immigrants raised the estimated undercount rate of the total population (by about 0.4 percent for every 1 million undocumented immigrants), the male/female and race differences in percent undercount were insensitive to the alternative assumptions. The undercount rates for males were

consistently higher than for females across all sets of estimates, and the undercount rates for Blacks were substantially higher than the undercount rates for the White-and-other-races population.

The estimates of coverage resulting from this application of demographic analysis provided measures of net underenumeration in the census—the combined effect of omissions, erroneous inclusions (including duplications), and reporting errors (for age, sex, and race/Spanish origin categories). Because demographic analysis involved working with aggregated data from both the census and independent sources, it could not separate the individual components of net underenumeration. These had to be addressed through matching studies, such as the PEP and others described below.

Post-enumeration program (PEP)—The 1980 PEP undertook to measure census coverage directly through sample survey methods. Samples of persons were selected to check whether they had been counted in the census, and samples of enumerated persons were selected from the census to determine whether they had been counted correctly. This case-by-case approach contrasted with that of demographic analysis, which relied on aggregate statistics. The strategy of evaluating the census at the level of individual enumerations required the PEP survey design to incorporate many features of the census design itself. (See ch. 1.)

The PEP used three separate surveys as its principal sources:

- 1. The April 1980 Current Population Survey (CPS) sample, comprising approximately 84,000 noninstitutional households.
- 2. The August 1980 CPS sample, of the same size.
- 3. The so-called “E” sample—approximately 110,000 households selected from the census itself.

The “P” samples—The two CPS samples, known in the PEP as the “P” (population) samples, were supplemented for the PEP with a sample of military persons in order to represent the total noninstitutional population. There was also a separate P sample of institutional persons.

The purpose of the P samples was to measure the proportion of persons missed in the census. The staff derived this estimate by trying to match the samples to the census. In cases where the sample persons had moved between Census Day (April 1, 1980) and the time of the CPS interview in August, an attempt was made to obtain the Census Day address for matching purposes. In both April and August, the interviewer collected information and also drew a sketch map locating the CPS address relative to major roads in the area. The staff then used the map to determine each CPS household’s location in terms of census district office, enumeration district (ED), and block to facilitate matching. Approximately 86 percent of the P-sample cases, excluding noninterviews, matched the census

in the first attempt. If the census questionnaire could not be located or if some persons were not listed on it, the CPS case was returned to the field for reconciliation, principally in the winter and spring of 1981.

The "E" sample—The E (enumeration) sample was chosen from the census in clusters of 10 housing units per sample ED, with a 50-percent subsample, averaging about 5 households per ED, selected for a within-ED search for duplicate listings. Names and other information for the subsample households were transcribed to separate forms, which clerks used in their searches.

One purpose of the E sample was to estimate the number of occasions when a person was erroneously included in the census at a particular address, such as someone who had moved (from the address at which he/she had been enumerated) to a new permanent residence before Census Day, or a college student living on campus but enumerated instead (contrary to census residence rules) at his or her family home. Another E sample purpose was to estimate the number of erroneous enumerations caused by duplication—i.e., someone counted in more than one place.

A third E-sample purpose was to estimate the number of enumerations mistakenly included in the wrong ED, but far enough away from the correct ED to miss being found and matched in the P sample's search area. These figures were calculated for use in dual-system estimation (see below).

Dual-system estimation—The staff used dual-system (or capture-recapture) estimation in the PEP as an attempt to compensate for the P sample's imperfect coverage. The methodology involved making and applying the following five specific, underlying assumptions about the nature of that coverage.

1. The number of distinct persons correctly enumerated in the correct ED or within the effective P-sample area of search, and who were recorded with adequate information for matching purposes, could be estimated mathematically within each of the stratification cells employed in the dual-system estimator.
2. For each complete case, the combined effect of the original CPS interview and the followup interview, if necessary, resulted in the information needed for matching to the census, i.e., adequately represented name and demographic characteristics, together with geographic information on the Census Day address sufficient to define a P-sample area of search that contained the correct ED.
3. Whenever adequate information was judged to be available in the P sample for purposes of matching, the clerical match occurred without error.
4. The assumptions about missing data in the P sample and the nonresponse adjustments in which the assumptions were reflected yielded estimates of (a) the weighted sample

total from the CPS and (b) the weighted sample estimate of the number matched between the two P samples. These estimates represented the effect of matching to the census if matching had been possible for the entire population represented by the CPS in the absence of missing-data problems.

5. Within each stratification cell, the estimated underlying match rate was essentially identical (ignoring finite population effects) to the estimated rate at which the census correctly captured unique individuals within their P-sample area of search.

The last of these assumptions represented a general notion that census coverage and CPS coverage were statistically independent processes. Because the given population was finite, exact statistical independence generally could not occur for a given realization of the census. Alternatively, the last assumption could have been viewed in practical terms, namely, that the CPS universe within a stratification cell provided an estimate with negligible error of the census's capture rate. Subsequent evaluation tended to indicate that each of the five assumptions was incorrect or might have failed because of matching errors, missing data in the P and E samples and their treatment, errors in Census Day addresses for movers, the CPS rotation design and its effect on census coverage, and postal carriers' failure to spot erroneous addresses, as well as limitations inherent in the five assumptions themselves.

PEP estimates of the census undercount—To accommodate the results of the evaluation (i.e., of how well the assumptions held) described above, the Census Bureau staff constructed 12 sets of dual-system estimates based on the PEP data. Each of the sets arose through the selection of one out of five P-sample sets of estimates and one out of three E-sample sets. Each set, which differed from the others in either source or construction, or both, then was examined in association with its dual-system estimate (which, as noted above, incorporated estimates from both the P and E samples).

Estimates for the total population by race and ethnicity for the national undercount ranged from an estimated overcount of 1.0 percent to an estimated undercount of 2.1 percent—a difference much larger than the effect of sampling error. (The undercount for the institutional population, calculated separately and not considered in any of the other studies, was estimated at approximately 4.0 percent, with a standard error of 1.9 percent.)

When national estimates were compared, it appeared that changes in the choice of estimates from the P or E samples had approximately additive effects: By defining the effect of the choice between two P-sample sets as the percentage-point difference in the estimated undercount for a fixed E sample, the resulting effect was essentially the same, regardless of which E sample was selected for the comparison. Similarly, the effect of the choice among E-sample alternatives was virtually the same

over different P-sample sets. The 12 sets (see the table below) consistently showed a greater undercount for Blacks and non-Black Hispanics. When applied to total State or regional populations rather than to the Nation as a whole, the undercount/overcount estimates varied considerably, more so among the P samples than the E samples; it appeared, however, that the western States had been disproportionately undercounted. Still wider differences were noted when the 12 sets were applied to 16 major cities.

Dual-System Estimates of Percent Undercount for the Noninstitutional Population, by Race and Ethnicity, Ordered by the Estimated Total Undercount

Set of dual-system estimates	Total	Black	Non-Black Hispanic	Others
14-8	-1.0	1.1	0.0	-1.3
14-9	-0.5	2.3	1.2	-1.1
14-20	-0.2	2.8	1.5	-0.8
10-8	0.3	2.8	3.7	-0.4
3-8	1.0	5.7	4.5	0.0
2-8	1.1	6.1	4.7	0.0
3-9	1.4	6.9	5.6	0.2
2-9	1.5	7.3	5.8	0.3
5-8	1.7	4.5	6.6	0.9
3-20	1.7	7.4	5.9	0.5
2-20	1.9	7.8	6.1	0.6
5-9	2.1	5.7	7.8	1.2
Approx. s.e. (sets 2, 3, 14)...	.2	.6	.8	.2
Approx. s.e. (sets 5, 10)2	.6	1.0	.2

SOURCE: U.S. Bureau of the Census, Evaluation and Research Reports of the U.S. Censuses of Population and Housing, Series PHC80-E4, *Coverage of the Population in the 1980 Census*, table 7.1.

Evaluation findings—When the results of the PEP and demographic analysis were combined and their limitations taken into account, the Census Bureau staff arrived at the following conclusions:

1. The net census undercount of the total population was significantly lower in 1980 than 1970. Assuming that approximately 2 million undocumented aliens were included in the 1980 census, this implied that the count of the legally resident population was the most complete in 1980 of any census.
2. The improvement in coverage in 1980 (compared with previous censuses) extended to the Black and White-and-other races populations separately.
3. In spite of these coverage gains in 1980, the undercount rate for Blacks continued to exceed substantially the undercount rate for the White-and-other races population, and there had been relatively little—if any—change in the differential between those two rates. (See p. 8 above.)

4. The PEP provided the only evidence on a 1980 undercount of Hispanics—suggesting approximately the same magnitude as the differential undercount of Blacks, with the Hispanic undercount rate consistently exceeding that for non-Hispanics.
5. Demographic analysis, as it had since 1940, indicated substantially higher undercount rates for males than for females, not only for the overall population but for Blacks and Whites-and-other-races separately. The PEP did not show this, but may have failed to measure fully the relatively high undercount of males.
6. Demographic analysis also revealed that the census undercount rates varied considerably by age. In particular, large differences in undercount rates by sex occurred principally in the 25-59 age range for each race group. The PEP captured some of the same pattern of variation by age, although it failed to capture the higher undercount rates for adult males.
7. Historically, the South had appeared to experience a disproportionately higher undercount than the rest of the country. In 1980, however, the PEP estimate for the South was close to the national average. Combined evidence suggested a significantly greater increase in census coverage in 1980 over 1970 for the South than for any other region.
8. The PEP confirmed results from the 1980 housing-unit duplicates study (see below) that an appreciable fraction of the total census count, probably in excess of 1.1 percent, represented duplicate enumerations of persons already in the census.
9. Misassignment of housing units to the appropriate census work units (i.e., enumeration districts or census blocks) appeared far more extensive in rural areas that were prelistered than where conventional, door-to-door enumeration took place. (Such mistakes could have come from a number of sources.)
10. The net coverage error of the census, although relatively small, really represented a balance between omissions and erroneous enumerations of persons. The two opposing errors were substantially larger than the resulting net error in the census. (PHC80-E4, PERM 130)

Housing-unit coverage studies (HUCS)—These studies were designed to provide data on housing-unit coverage in 1980 for planning future censuses. Their primary purpose was to provide national and regional estimates of the gross underenumeration rate for occupied housing units, and the overenumeration rate for occupied housing units where the overenumerated units also had overenumeration of at least one household member.

The HUCS consisted of two separate studies. One, the CPS-census match, measured the missed rate of housing units in the 1980 census. The other, the duplicates study, measured the duplication rate for occupied housing units that had at least one duplicated household member.

The CPS-census study consisted of matching an independent listing of about 37,000 housing units (a subsample of the April 1980 CPS) to the census records to determine the enumeration status of each unit. Interviewers visited the units that could not be matched to obtain additional information for matching purposes. These units were rematched to the census, and any that were not found were assumed to have been missed in the census.

The duplicates study was divided into two parts—the within-ED component and the between-ED component, both obtained by screening the cases selected for the E sample (see p. 9 above). The within-ED component consisted of occupied E-sample housing units in which at least one household member had been found to be enumerated more than once within the ED. For the between-ED component, records for E-sample units that had geographic coding problems—i.e., those where their ED assignment was uncertain—were examined to see if any of their household members had been enumerated in nearby ED's as well. If at least one member had been, an interviewer visited the unit to determine whether both addresses represented the same unit.

The HUCS estimated the following:

1. Housing-unit coverage in the 1980 census remained at about the same level as in 1970. The missed rate in 1980 for all housing units was 2.6 percent for the Nation. The rate for occupied units was 1.5 percent, while 12.56 percent of the vacant units were missed.
2. The duplication rate for occupied housing units that had at least one household member duplicated elsewhere was 0.86 percent. The most common reason for duplicate enumeration of occupied units was clerical or enumerator error (44.3 percent), followed by geographic coding error (27.5 percent).
3. Among regions, the South had the highest duplication rate of occupied units that had at least one household member who was duplicated. The missed rate for the South was significantly higher than those of the Midwest and West, but was similar to that of the Northeast.
4. Rural areas had higher rates than urban areas for missed occupied units, missed vacant units, and duplicated occupied units that had at least one household member duplicated elsewhere.
5. Units located outside metropolitan areas had higher missed rates for vacant units and higher duplication rates for occupied units that had at least one household member duplicated elsewhere than units inside metropolitan areas.
6. Prelist areas had higher rates for all categories than all other types of enumeration areas.
7. The entire household was duplicated in about 88 percent of the duplicated housing units with at least one member duplicated elsewhere.
8. The rate at which occupied housing units remained misclassified as vacant was at least 0.5 percent, perhaps slightly higher than the 1970 residual rate of misclassification. (PHC80-E1)

Administrative-Record Matching

A third method of estimating coverage used for the 1980 census was matching census records against other data bases. Several of the studies are described below.

CPS/census retrospective study—The purpose of this project was to experiment with reverse record-check procedures for tracing purposes—i.e., finding someone after the original contact. This study took one rotation panel (19,794 people, or about one-eighth of the full sample) from the March 1977 Current Population Survey (CPS) and matched it to the 1980 decennial census. To determine a match status, the sample person had to be found in the census, or be contacted to verify his/her address on Census Day. The main purpose here was to examine the nonmatch and not-traced rates for this coverage-measurement method.

There were five stages in determining a match status for each person: (1) Clerks in the Census Bureau's Jeffersonville, IN facility looked for the people in the census files at their March 1977 addresses. (2) If they were not found there, a new address was sought in the 1979 IRS (Internal Revenue Service) individual master file. (Only matched or out-of-scope persons could be determined from these stages, as anyone not found could have been living at a different address on April 1, 1980.) (3) Each household found thus far was sent a mailback questionnaire. (4) Nonresponse cases and postmaster returns were referred for telephone followup. (A person could be determined to be a match, nonmatch, refusal, or out-of-scope case at stages 3 and 4 when a 1980 address had been obtained.) (5) Field followup, leading to a residue of persons still not found and therefore categorized as "not traced." These five stages were carried out between 1982 and August 1983, reflecting a 3- to 6-year tracing period.

With subsampling weights and noninterview adjustments, the study produced an estimated national nonmatch rate of 14 percent and a not-traced rate of 4.8 percent. The nonmatch rate was comparable to the IRS/census direct match study (see below) but was about twice as high as the gross nonmatch rate in the 1980 Post-Enumeration Program (see above). The not-traced rate was slightly higher than in the IRS/census direct match study, which used the 1979 IRS file. The 1976 Canadian reverse record check (using a 5-year trace period) had the

same not-traced rate as the CPS/census study, while the 1960 U.S. reverse record check (using a 10-year trace period) had a not-traced rate over twice as high as the CPS/census study. The nonmatch and not-traced rates for Blacks and other races were about twice as high as for Whites, but the nonmatch rates might have been affected by recall bias because of the 2-year time lapse. As expected, the highest not-traced rates occurred in the 18-24-year-old age group. (Census/SRD/RR-86/13)

CPS/IRS administrative records match—Research into triple-system estimation required matching the Current Population Survey (CPS) to an Internal Revenue Service (IRS) file extract. The match was based on social security number (SSN). To estimate the proportion of SSN matches that represented true name matches, as opposed to SSN matches alone, a sample of records was clerically reviewed. Over 77,000 of the February 1978 CPS records that had SSN's were sent to the Social Security Administration (SSA), which matched them by age, race, sex, and date-of-birth characteristics with the SSA summary earnings records. Almost 59,000 of these records, which received validation codes based on the results of this match, then were aggregated into four strata for sampling and analysis. Another 12,000 of the 92,000 CPS records—roughly half with SSN's and the other half without—were sent to the SSA to be matched to SSN's on the basis of a Soundex surname code. (Soundex was a system for coding names phonetically as an aid to finding them in large data bases.) This search resulted in about 3,600 SSN matches, and these also were sampled and evaluated. There were two followup procedures as well, in which the CPS control cards were checked to try to find a CPS name for matching to the given IRS name. During final review, the staff developed a set of eight final match codes from which to determine final match rates, and investigated alternative match rates based on various combinations of match codes. In the first cycle of evaluation, approximately 6 percent of the SSN matches were found not to match on name. In the second cycle (using Soundex), approximately 3 percent did not match. This implied that SSN's determined through Soundex represented name matches more often than those obtained in the CPS from respondents or interviewers. The results indicated that the erroneous match rate was sufficiently severe to warrant undertaking another study of this type, in which cases from the PEP (post-enumeration program) would be matched with the 1980 IRS tax-return file to provide another estimate for comparison. (PERM 21)

IRS/census direct match study—This project had two principal aims: (1) To investigate the feasibility of using the IRS individual master file (IRS/IMF) as a frame for matching to the census in order to estimate gross undercoverage in the census, and (2) to study the difficulties in tracing individuals to the census using the IRS/IMF address. Almost 11,000 persons from the IRS file were sampled by race, sex, and region for matching to the census; almost 40 percent were not found and were sent mail

questionnaires (at their IRS/IMF addresses) asking where they lived on Census Day 1980. As this experiment took place several years after Census Day, the postmaster return rate (18.5 percent) was high, as expected, but the nonresponse rate (60.2) was higher than anticipated. A further subsample (1,500 cases) was followed up by telephone, but only about 39 percent of the calls resulted in completed interviews. One-fourth of the persons still untraced after telephone followup were then assigned for field followup. The highest not-matched rates (up to 36.6 percent) were found in the 18-24 and 25-34 age groups; the overall percent not-matched was 12.6 for all races age 18 to 64. The percent not matched was 11.1 for non-Black, non-Hispanic; 21.5 for Black, non-Hispanic; and 19.3 for Hispanic. (RR-84/11)

EXPERIMENTAL PROGRAM

Alternative Questionnaires Experiment

Census tests during the 1970's indicated that mail-return rates were dropping to such an extent that field costs for nonresponse followup could be adversely affected in the 1980 census. This experiment tested the effect of questionnaire design on mail-return rates, item completion rates, and reported characteristics. It was estimated that a 1-percent increase in the mail return would save \$2 million. Concern with data quality and respondent burden also underlay the experimental purposes.

Two sets of experimental questionnaires were designed with different appearances than the standard short- and long-form household questionnaires. The first set (linear FOSDIC-readable forms) had 100-percent population questions reformatted (e.g., race, age, and sex) into horizontal rows rather than in vertical columns. In addition to the linear formats, the long form also had some rearrangement in the question order and sequence and some wording changes. The second set (non-FOSDIC forms), prepared by a contractor specializing in document design, focused on a questionnaire design that the public might find more attractive and easier to understand. Compatibility with Census Bureau data processing was disregarded, as it was felt that such requirements could be met in 1990 if this approach yielded a higher mail return or item-completion rate. Examples of this set's design differences were a different cover, expanded instructions, different question sequencing, use of check boxes, avoidance of skip patterns, and wording changes.

A sample of district offices, stratified by type (centralized or decentralized), was selected, and approximately 18,000 addresses from them were designated to receive either standard 100-percent or sample questionnaires or one of the alternative forms. Due to packaging and delivery problems, only 14,400

cases were usable. The resulting data were weighted to estimate mail-return rates on a national level for each set of questionnaires, 100-percent (short) vs. sample (long) and centralized vs. decentralized.

Analysis suggested that with regard to mail-return rates, the length of the questionnaire had a larger effect than the questionnaire version, with all the short-form variants being returned at higher rates than the long forms. There was little difference in the rates at which the long forms of the three versions were returned. Both of the experimental short forms were returned at a slightly higher rate than the standard short forms. Item nonresponse rates for the various forms were inconclusive: The non-FOSDIC short form appeared to have been filled less well than either the linear or the standard census forms, which differed only slightly. Other hypothesized advantages of the experimental forms (lower nonresponse than other forms with regard to items such as size of household, race or Spanish origin, birth date, school attendance, income, etc.) were not observed in the edited file. (PERM 16, 19)

Telephone Followup of Nonresponse Experiment (TFE)

This study was part of a program designed to improve census-taking procedures. The TFE's major objectives included (1) evaluating the efficacy of using telephone followup for nonrespondents in mail census areas (in terms of operational complexity and cost efficiency), and (2) measuring the impact of both personal-visit and telephone data-collection techniques on various nonsampling errors.

Based on a formula for anticipated mail-return rates, seven strata were defined, each containing one randomly selected centralized or decentralized district office. Separate systematic samples of long- and short-form nonresponse households in single-unit structures were chosen from the overall sample, so there were about 1,000 nonresponse cases in each of four groups to be interviewed—short-form telephone, short-form personal visit, long-form telephone, and long-form personal visit. (Single-unit structures were chosen because the "crisscross" telephone directories from which their telephone numbers would be obtained did not include apartment designations at any address. Two census regions [Northeast and South] were not represented because their crisscross directories were not available at the time.)

Regular census followup procedures were varied as little as possible for the experiment. The alternative interviewing techniques did affect results, however. Telephone enumerators had access to office records of late mail returns, but no access to proxy information (i.e., from a neighbor) about vacancy status. Personal-visit interviewers, on the other hand, had access to proxy information that clarified vacancy status, but could not verify the late return of a questionnaire; the latter resulted in a large number of duplicate questionnaires.

Only a preliminary evaluation of this project was possible. The general conclusions were that telephone followup was less costly and took less time than personal visits. The number of "last resort" (minimal information) cases in telephone followup was about half that of the visits, and the number of unanswered questions was also lower. Refusal rates were not statistically different, however. (PERM 58)

Update List/Leave (UL/L) Experiment

This operation began on March 11 and continued through March 26, 1980 (just before Census Day). It involved having an enumerator canvass an enumeration district (ED), visit each housing unit, and compare what was "on the ground" with what was listed in the master address register (MAR). The listings and maps were updated and housing units were added or deleted as necessary. The enumerator added household names and telephone numbers to the MAR, and left a short- or long-form questionnaire as the MAR designated (as well as a continuation and/or Spanish-language questionnaire where needed). Special places (e.g., group quarters) were reported to the crew leader.

Five district offices (Dayton, OH, N.E. Central Chicago, IL, Yakima, WA, Greenville, NC, and Abilene, TX) were chosen for this experiment, and five other offices (Columbus, OH, N.E. Chicago, IL, Bellingham, WA, Florence, SC, and Lubbock, TX) were paired with them as the controls. Some of the pairs proved to have significant differences, which appeared to affect the results. Enumerators from the UL/L offices canvassed close to a million housing units (roughly half in TAR [tape address register] and half in prelist areas). Of these, 54.5 percent (adjusted for vacant units) were actually contacted. Based on the data for the contacted units only, which may not have been representative of all housing units in either the district offices or the enumeration districts, the experiment had these findings:

Contact rates were lowest in urban areas, in part because of problems gaining entrance to secured high-rise buildings.

Few persons refused to give their telephone numbers.

Over half the listings deleted in this operation eventually were enumerated, although fewer deleted units had to be reclassified as occupied than in the control offices. The estimated delete rate in UL/L offices averaged 3.7 percent, whereas the estimated overall delete rate (after nonresponse followup) was 9.2 percent.

The operation was quite successful in identifying additional housing units at structures originally listed as single units. (The overall UL/L housing unit add rate was 5.6 percent as against the control rate of 4.7 percent.) UL/L enumerators added units to at least two-thirds of the single-unit structures converted to multiunit structures, whereas the proportion was about half in the control offices.

The operation did not seem to have had much impact on the number of requests for foreign-language assistance.

UL/L enumerators identified vacant housing units more accurately. The district offices using the UL/L procedure had lower percentages of units misclassified as vacant (8.8 percent, vs. 16.5 percent for the control offices). Both the experimental and the control offices had similar estimated percentages of units misclassified as occupied, however. (PERM 96)

Employee Selection and Training

These census operations were considered extremely important for 1980. There were three evaluation projects related to employee selection methods and three experiments related to training.

Development and validity of employee selection tests—The Census Bureau’s recruitment objective was to have a staff in each district office that was representative of the population of the area it covered. This meant that goals were set for employing a certain number of women and minorities—Blacks, Hispanics, Asians, Pacific Islanders, Native Americans—or persons with proficiency in certain languages, such as Spanish, Chinese, Korean, etc. It was believed that a representative staff would achieve the best count possible in each area. Along these same lines, efforts were made to employ enumerators who lived in the ED’s they covered. Job candidates had to pass a written test and meet other minimal qualifications. There were two versions of the test, one for higher-level supervisors and one for lower-level supervisors (such as crew leaders) and nonsupervisory employees. The tests were designed to determine whether candidates could perform census-related tasks. A Spanish-language version of the lower-level test was also available on request in some areas.

In all, about 1.2 million persons were tested for census jobs, and about 80 percent passed. About 460,000 persons were employed at one time or another in the census district offices, with 270,000 working at the peak of activities in April and May 1980. These positions included enumerators, crew leaders, office clerks, and supervisory personnel. (See ch. 5.)

Selection aids validation study (SAVS)— This study developed employee selection procedures by which the Census Bureau could make valid inferences regarding job performance for all racial, ethnic, and sex groups.

SAVS’ content validation phase was designed to establish the job relatedness of the selection procedures (i.e., the written test, interview guide, reference check, and relevant parts of the application form). The basis of the content validation study was analysis, in terms of work tasks and worker characteristics, of the following census jobs:

Nonsupervisory	Supervisory
Enumerator	District office manager
Crew leader	Field operations supervisor
Office clerk	Office operations supervisor
Senior office clerk	Administrative operations supervisor
	Special place operations supervisor
	Field operations assistant
	Office operations assistant

Job-analysis data were gathered through various methods, including questionnaires and personal interviews. The tasks were ranked in importance and their qualification requirements were evaluated. The most important job requirements had been used in constructing the written tests and other selection procedures, so there was a relationship between the content of each selection procedure and the content of the job.

Both written tests (supervisory and nonsupervisory) were analyzed statistically through preliminary tryouts at census headquarters. The nonsupervisory test was evaluated through experiments conducted during the 1977 test census of Oakland, CA and the 1978 dress-rehearsal census in lower Manhattan, NY. Evaluation included various statistical analyses for such purposes as improving the psychometric properties of the written tests; enhancing the fairness of the instruments for members of various racial, ethnic, and sex groups; and estimating reliability. Evaluation results were applied in revising the tests, setting passing scores that were fair to the demographic groups under study, and adjusting the procedures governing the use of all the selection processes (e.g., administration, scoring, interpretation of results, and security).

The test development and evaluation procedures followed relevant provisions of the *Uniform Guidelines on Employee Selection Procedures* (adopted in 1978 by the Office of Personnel Management, the Equal Employment Opportunity Commission, and the Departments of Justice and Labor), *Standards for Educational and Psychological Tests* (American Psychological Association, 1974), and *Principles for the Validation and Use of Personnel Selection Procedures* (Division of Industrial-Organizational Psychology, American Psychological Association, 1975). The study started in late 1975 and was completed in 1979, when the final version of the 1980 employee selection procedures was released to the Census Bureau’s executive staff and the Field Division. The study’s report, “1980 Field Employee Selection Procedures, A Content Validity Study, 1975-1979,” was issued in 1981 in two parts—A, Nonsupervisory Procedures, and B, Supervisory Procedures. Other aspects of this study are discussed separately below.

Adverse-impact determination for nonsupervisory procedures—

Following the conclusion of most of the recruiting and hiring of nonsupervisory employees (mostly enumerators and clerks), this project evaluated the employment rates actually achieved for several race, sex, and ethnic groups in accordance with Title VII of the Civil Rights Act of 1964, as amended, and Executive Order 11246. "Adverse impact" was defined as a substantially different rate of selection in hiring, promotion, or other employment decisions that worked to the disadvantage of members of a race, sex, or ethnic group. A practical means of defining adverse impact under Title VII was the "4/5ths" or "80 percent" rule: Comparing the selection rates for different groups of applicants to determine whether rates for any race, sex, or ethnic group were at least 80 percent of the rate for the group with the highest selection rate.

The study involved reviewing race, sex, and ethnic-group information for about 62,000 applicants from a sample of 26 mailout/mailback district offices (reduced to 20 when 6 were found to have incomplete information). Sampling weights were applied to the resulting distributions of race, sex, and ethnic groups to produce estimates of each group's national population. (This step was necessary, as a larger number of minorities than non-minorities were selected for the unweighted sample [because offices with small minority populations were under-represented in the sample] to assure adequate representation of Blacks and smaller groups such as American Indians and Asians.) Selection information from each stage of the selection process, including written tests and structured interviews, was collected for each sample office. Evaluations of the selection rates for the total selection process provided no evidence of adverse impact for any race, sex, or ethnic group. Individual component selection rates indicated that there was clear evidence of adverse impact for the Federal suitability requirements and the interview. Adverse impact in selecting interviewers appeared to be related to the bilingualism requirement imposed on applicants in largely bilingual census areas.

The effect of interview preference for candidates referred from political sources was ambiguous. In the sample, Black and Hispanic applicants had referral rates lower than 4/5ths of the White rate, but the quality of those referred was better than nonreferred Black and Hispanic applicants. The effect of interview preference provided on the basis of the test score could not be determined, as there were no accurate records on how the preference procedure was applied at the enumeration-district level. The effects of other selection criteria, such as indigenouness and cultural familiarity could not be evaluated, but the study concluded that these variables probably did not have a negative impact on race groups, since the total selection process showed no evidence of adverse impact. If anything, these variables probably aided in obtaining a representative work force. (PERM 41)

Predictive validity project—This project evaluated the Field Employee Selection Aid Test—General (FESAT—G) used in hiring enumerators during the 1980 census and in predicting

job performance. It used the same sample design as in the adverse-impact study (above). The staff developed two primary measures of job performance and job standards for followup enumerators: The longevity measure included the number of weeks on the job and completion of the work assignment; the production measure covered the time spent per form (corrected for unacceptably completed forms), total forms, and field hours worked per form.

Results indicated that the test was a valid predictor of enumerators' job success on the average, although the test did not seem to predict performance in several of the centralized offices sampled. The overall validity coefficient was .379, but on the average, the test had higher validity in decentralized offices and no predictive validity in centralized offices. The test was found to be fair to members of various race, sex, and ethnic groups by providing statistically equivalent regression lines for predicting enumerators' success. (A similar study, covering clerical positions, had similar results, but was not published.) (PERM 107)

Qualification Tests for Coding

Industry and occupation—For the 1980 industry and occupation (I&O) coding operation, qualification tests were administered to prospective coders following training. (See ch. 6.) This project documented the coder qualification methods and summarized the test results. The score distributions were analyzed, and the premise that test results are useful as indicators of coder ability was examined.

To qualify for coding, clerks were required to pass a test consisting of a deck of questionnaires containing artificial data. Following training, clerks took a practice test (deck A) followed by a first qualification test (deck B). Those who did not pass test B took test deck C. An error rate of 12 percent or less on test deck B or C was passing. Those failing both tests did not qualify for I&O coding.

The study indicated that there was a tendency, at all three processing offices, for clerks who passed the first qualification test to have cumulative coding-error rates below the acceptable performance level (8.25 percent on an item basis) and for clerks who failed the first qualification test to code above the acceptable error level. With an expected failure rate of 8 percent, only 2 percent of the clerks at Jeffersonville failed to qualify, but 12 percent failed at Laguna Niguel, while clerks at New Orleans conformed to the expected rate. Beta distributions were fit to the scores of three of the first-qualification tests, but the other sets of scores were highly skewed statistically and did not fit any known distribution. (PERM 29)

General coding—During their training, prospective general coders were tested for qualification, which was obtained if a test was scored less than or equal to a predetermined error rate level (12 percent with a full deck, 9 percent with half; a full deck was always used in the second test). Clerks were permitted two

chances to qualify. Based on pretest and dress rehearsal experiences, the expected failure rate over all processing offices: Jeffersonville, 1.4 percent; Laguna Niguel, 4.5 percent; and New Orleans, 6.3 percent. Of the clerks who completed the qualification process (i.e., those who passed the first test plus those who qualified on the second test after failing the first one), there were still some (about 4 percent) who failed the course: Jeffersonville, 0.6 percent; Laguna Niguel, 3.9 percent; and New Orleans, 4.3 percent.

For all three processing offices, there was a statistically significant tendency for a clerk who qualified on the first test to produce work with an average error rate below the 1.8-percent level required for acceptable performance. Similarly, a clerk who qualified on the second test tended to produce work an unacceptable level—with an average error rate above 1.8 percent. Within each processing office, the distribution of scores on the first qualification tests most frequently used did not differ significantly from a Gamma distribution. (PERM 78)

Place of work/migration coding—Prospective POW/Mig coders were given qualification tests after several days of classroom training, and were deemed qualified if their test error rate was less than or equal to 15 percent for a full deck or 13 percent for a half deck. Clerks were permitted two chances to pass. The test data from New Orleans were incomplete, but it was estimated that the actual failure rate across the three processing offices was approximately 4 percent. At Jeffersonville and Laguna Niguel, the percentage of clerks failing the qualification process was 1.7 and 6.1 percent, respectively.

Analysis of the data for Jeffersonville and Laguna Niguel showed, as in the other types of coding, that qualifying on the first test was associated with cumulative coding error rates less than the acceptable performance level (5.25 percent), while qualifying on the second test was associated with cumulative production coding error rates greater than the acceptable level. (PERM 88)

Evaluation of Training Methods

Experimental intern program—The Experimental Student Intern Program (ESIP) was a feasibility study, announced and implemented during the summer of 1979, that was designed to assess the utility of employing student interns as census enumerators during the 1980 census. Fifty-four colleges and universities were invited to participate. Almost 1,500 students, faculty, and Census Bureau staff were involved in the program on 46 campuses and in 81 district offices.

ESIP's rationale was the need to reconsider standard recruitment and retention policies for data collection (some 1.2 million persons were recruited to fill about 460,000 positions in 1980). In previous censuses, this task had been especially difficult in many large metropolitan areas. The situation persisted during the 1980 test censuses, aggravated by high turnover among enumerators. The ESIP attempted to address this problem and

also the one of heightening student awareness of the kinds of data gathered in the population and housing censuses, with special emphasis on their collection and eventual use. University participation in the ESIP required that academic credit be given and that faculty members be involved. The instructors attended a seminar covering the program and were given curriculum materials for use in the spring of 1980. Students were paid during their appointments, which were for about 6 weeks in April and May 1980. The schools were allowed to decide details of credit, class schedules, and grades. After the census, all participants received questionnaires, and over 30 ESIP faculty, student interns, and Census Bureau staff participated in an evaluation workshop in Washington, DC in November 1980.

As the ESIP was a feasibility study and not a controlled experiment, and only about a third of the students responded to their evaluation questionnaires, only general program indicators were possible as results. Records from the regional and district offices indicated that the ESIP interns usually were not available to work 30 hours a week, and were not as productive as the regular enumerators. The interns did, however, tend to complete their assignments (63.6 percent) more often than the regular staff (54.0 percent), but these data are subject to varying local conditions. Half or more of the students responding to their questionnaires supported the ESIP concept and urged its continuation, but there was great variation among regions and schools. The faculty from nearly two-thirds of the ESIP sites were critical of the program and reported many unresolved problems. The general agreement among faculty, students, and Census Bureau staff was that student internships should be pursued further, but only if there would be substantial improvements in program communication and intern management below the regional level. (PERM 20)

Alternative-training experiment—This project compared job-performance-aided (JPA) training with standard Census Bureau training for field enumerators. JPA, which emphasized specially designed job reference manuals and aids (checklists, illustrations, schematics, decision trees, flow charts, and the like), was based on experience with these approaches in industry and the military services, but adapted to census requirements.

In 1980, standard census training used a "verbatim" approach in which trainers read word-for-word from a training guide, delivered lectures, employed audiovisual aids, and led learn-by-doing exercises. Most employees were trained by their supervisors. Both the standard and the alternative JPA training designs took into account several constraints: (1) Most census jobs were short-term (2-4 weeks), which argued against the use of expensive or lengthy training sessions. (2) Applicants for census jobs varied widely in age, education, and experience. (3) Much of the training (e.g., for enumerators) was conducted in small groups (8-12 people), in marginal facilities, and in thousands of sites. (4) Training was almost always conducted

by inexperienced trainers who received their own training only 1-2 weeks before. (5) Job manuals were an important reference source; workers would not be able to perform all tasks on the basis of recall alone. Both methods were perceived to have advantages and disadvantages, and were scrutinized in terms of cost-effectiveness.

Three pairs of decentralized district offices were matched on variables related to the difficulty of enumeration. Each office in a pair was randomly assigned to one of the two training methods, i.e., JPA or standard (the control). About 1,200 enumerators who received JPA training were compared with about 1,400 in the control group. Measures of enumerator attitudes toward the training were collected anonymously, once immediately after training concluded and again after 2 or 3 days of job experience; standard census administrative records provided data for enumerator performance and production indices.

JPA training differed from the standard kind most notably in materials preparation and packaging, in the followup-1 enumerator's manual, training activities, and stylistic variations in presentation. With respect to the training content, evaluation concluded that training manuals and accompanying materials could be simplified and reduced considerably without detriment to training or field performance; some manuals might be superfluous. Developing training guides, workbooks, and manuals concurrently resulted in more effective training. Neither of the two training approaches, however, adequately prepared enumerators for the reality of the job.

Evaluation of the instructional methods indicated that the enumerators' structured training generally was well received in both approaches, but that the JPA training was more effective and resulted in better job performance. It was found that group-learning activities (e.g., discussion, practice, and role playing) were possible without loss of instructor control, and that workbooks and evaluation exercises were effective ways to encourage active learning. (PERM 9, 23)

Job-enrichment training experiment—Job enrichment was an effort to increase enumerators' appreciation for the intrinsic value of the work they were doing and thus reduce attrition. It was tried through a feasibility study in one of the three Dallas, TX district offices. Prior to their regular training, over 150 newly hired enumerators for nonresponse followup had an orientation meeting with their crew leaders, at which they were offered the opportunity to represent the Census Bureau at local community meetings. About 70 accepted. (The primary hypothesis was that enumerators in the experimental group would be more apt to stay on the job after having made a public declaration of their Census Bureau affiliation. At the same time, they would add to the number of their district office's community-education contacts.)

Evaluation data were collected from administrative records, from the community organizations the enumerators visited, and from the enumerators themselves. Followup enumerators

in a centralized office in Houston, TX, served as a control group. Crew leaders and district office staff who participated in the study were interviewed about their perceptions of the experiment. Based on a survival analysis model, the study concluded that job enrichment had a positive effect on job tenure—enumerators given this opportunity were less likely to quit when other factors were held equal. (PERM 24)

COVERAGE-IMPROVEMENT EVALUATIONS

Effect of Special Procedures to Improve Coverage

The 1980 census employed a number of procedures designed to improve coverage of population and housing, and their evaluation gave particular attention to the extent to which coverage had been increased and at what cost. Enumeration in the 1980 census was controlled largely through address registers in which every housing unit and special place should have been listed and accounted for, either with an entry to show receipt of a completed census questionnaire or by some other notation. In sparsely settled areas, containing about 5 percent of the population, census enumerators prepared the address registers by filling in the necessary information as they visited each household and collected and/or completed a questionnaire on or after Census Day. The other 95 percent of the population was enumerated principally by mailing household questionnaires to geographically coded lists of addresses that, after computer processing, became the address registers used for control purposes. Lists for urban areas were purchased from commercial suppliers and updated by both the Census Bureau and the U.S. Postal Service. As these lists were received and maintained on computer tape, the end products were referred to as tape address registers, or TAR's, and the areas where they were used, TAR areas. In mail census areas outside the TAR areas, enumerators compiled and coded the initial mailing lists by canvassing their assigned areas and entering all the residential addresses by hand. This operation was called "prelisting" and the areas were known as "prelist areas." Both the TAR's and prelist address registers had to be prepared some months before the census began, to allow sufficient time for addressing and mailing the millions of questionnaires. All the registers, regardless of source, were subjected to quality checks before, during, and after the enumeration. (See chs. 3 and 5 for details.)

The procedures that were evaluated are discussed below in the general order in which they were carried out in the census—some before enumeration began, others during the enumeration, and a few toward the close.

Advance post office check (APOC I)—In the summer of 1979, the U.S. Postal Service examined, added to, corrected, and deleted entries from the commercial lists, and then double

checked the addresses designated as being undeliverable. (See ch. 3.) There were about 38 million addresses in the commercial lists. Evaluation, based on clerically matching the post office reports to a sample of the address registers, estimated that the Postal Service added 5 million addresses and changed, corrected, or deleted another 2.9 million already on the list. The Census Bureau geocoded the 5 million postal "adds" and then matched them against the census list, resulting in a net addition of 2.2 million addresses. The advance post office check was estimated to have cost about \$6.97 million (\$4.56 million to the Postal Service and the remainder for clerical and electronic processing in the Census Bureau). (PHC80-E3)

A separate study evaluated the quality of this operation. A sample of approximately 4,100 addresses from the commercial vendor's list, on cards, was not sent to the Postal Service during the APOC I updating operation. This national sample of addresses was matched against the cards the post offices added or corrected. It was found that the post offices added around two-thirds of the missing addresses when asked to update an existing address file. (PERM 55)

Casing and time-of-delivery post office checks—In early March 1980, local post offices received the household questionnaire packages they were to deliver at the end of the month. These addressed packages were for all the addresses on the census list after the advance post office check, the prec canvass, and the prelisting operation. The mail carriers "cased" them (i.e., sorted them in the order they would be delivered on their routes), reported any addresses that had been missed, and returned any mailing pieces that were duplicates or undeliverable. The Census Bureau then compared the reports and the returned mailing pieces with the census address lists and generated new questionnaire packages as needed. The post offices delivered these, together with the ones they already had, to households at the end of March. As the carriers covered their routes or inserted mailing pieces in postal boxes, they reported additional missed residential addresses and returned duplicate and undeliverable pieces. (See ch. 3.)

These two post office checks, sometimes called APOC II and III, were evaluated in the same manner as the first. The two checks were estimated to have resulted in the identification and enumeration of around 2 million additional housing units, or close to 3.4 percent of all the housing units counted in mail census areas. The cost of these two checks was estimated at \$9.29 million, of which about \$5.85 million went to the Postal Service and the balance for Census Bureau processing. (PHC80-E3)

Precanvass—This operation took place prior to Census Day in the more urban areas where the commercial mailing lists were used (the so-called TAR [tape address register] areas). Enumerators personally canvassed areas with copies of the census address registers after these had been updated from the

advance post office check. The enumerators verified the addresses' accuracy, deleted erroneous entries, added units as needed, and corrected both the addresses and the geographic coding. (See ch. 3.)

For evaluation purposes, a sample of enumeration districts was chosen after the census. Clerks matched the listings in the sample prec canvass address registers with those in the master address registers, and compared additions to the latter with the 1980 census computer records to determine the number and demographic characteristics of the persons and housing units involved. It was estimated that the prec canvass operation alone added 2.36 million addresses to the census at a cost of approximately \$11.8 million. (PHC80-E3)

Casual count—The purpose of the casual count was to enumerate highly transient individuals thought to have no permanent place of residence or who may have lived in several places.

Midway through the 1980 census-taking process, teams of two enumerators from centralized district offices were sent to places that transient individuals were expected to frequent, such as bus and train stations, welfare and unemployment offices, street corners, bars, pool halls, and other such places. The enumerators attempted to interview persons in these places and determine whether they had been counted. At the district office, casual-count records were matched to the census to see whether any persons had been enumerated there, possibly without their knowledge. (See ch. 5.)

For evaluation purposes, a random sample of district offices was chosen and the casual-count procedures were duplicated clerically, including matching to the census, based on district office worksheets. The evaluation estimated that the total number of persons added was only around 13,000 (0.05 percent of the centralized census population), but with a large standard error (7,600), at a cost of approximately \$246,000 (\$18.60 per added person). (PHC80-E3)

Census questionnaire coverage items and dependent roster checks—The purpose of this effort was to improve coverage of persons and housing units through the use of special questions and edits. For example, question 1 asked respondents to list all household members on the outside of the questionnaire. If this list disagreed with the number of person-columns filled inside the questionnaire, a followup interview was conducted to resolve the differences. Question H4 was intended to identify missed housing units within small multiunit structures. In areas where the mail census was used, a label on the questionnaire cover indicated the number of questionnaires mailed to units with the same basic street address. The H4 entry (inside the questionnaire) asked, "How many living quarters are at this address?" If the H4 entry was larger than the number on the label, the original master address register (MAR) was checked; if the discrepancy still existed, it was followed up. Three additional questions (H1-H3) were also designed to verify the

household roster's completeness. (See ch. 12.) Persons listed in response to these questions were verified and added to the census as the result of followup operations. (See ch. 5.) The dependent roster check also was designed to improve within-household coverage for households where followup occurred for any reason. At the time of the field interview, respondents were asked to verify whether any persons were left off the original roster.

Clerks reviewed questionnaires from 260 ED's (a systematic 1-in-1,000 sample of mail-census ED's). Questionnaires that originally had failed the H4 edit were matched with the master address registers to see what change had taken place. The review determined that 230 of the sample ED's had no H4 adds. Overall, the evaluation indicated that an estimated 93,000 housing units (0.1 percent) were added to the census through H4 followup at over 2 million addresses. (PHC80-E3)

Whole household usual home elsewhere (WHUHE)—This operation was designed to correctly enumerate households temporarily away from their usual residence on Census Day and living in such places as vacation cottages or rental homes. In previous censuses these households, if identified as temporary residents, were assumed to be enumerated at their usual place of residence. The 1980 census procedures included a clerical check for the usual place of residence also, to make sure that the household was enumerated there. If not, it was added to the census at that usual address. In any case, the temporary housing unit was counted as vacant. (See ch. 5.)

Based on a review of material in the census allocation and program evaluation (CAPE) sample, at most, 1 million persons were reallocated via the WHUHE operation, and about 200,000 of these were counted in at least two places (because their listings at WHUHE addresses had not been cancelled). The evaluation also found that census clerks and enumerators had great difficulty in recognizing, coding, matching, and correctly processing the questionnaires for WHUHE units. (PERM 89)

Nonhousehold sources (NHHS) program—The objective here was to reduce differential undercoverage of minority populations. The program was based on matching independent lists of names and corresponding addresses to the 1980 census during the actual enumeration in areas thought to contain minority populations. Due to processing difficulties, individuals living in large multiunit structures were excluded from the match. Persons determined not to have been enumerated were assigned for a followup procedure. Those persons found to have been missed by the census were subsequently enumerated. (See ch. 5.)

The NHHS program was a relatively new one for the 1980 census, and was one of the few procedures directed at improving within-household coverage. A very small version of this program was tested in the 1970 census as the District of Columbia drivers' license test, which indicated that some success could be obtained from using drivers' licenses as an

independent source list. However, the 1970 test was conducted on such a restricted basis that the results could not be generalized. The 1980 testing cycle thus included several trials of this procedure. (See ch. 2.)

For 1980, the program used lists of names and addresses from departments of motor vehicles, the U.S. Immigration and Naturalization Service, and the 1979 New York City public assistance files. Furthermore, to facilitate the matching operations, the program was instituted in selected ZIP-Code areas where the Census Bureau could code addresses geographically by computer. These areas contained most of the highly urbanized portions of the United States.

Evaluation of the NHHS program was based on a review of a sample of records from 409 district offices. Analysis of the data indicated that about 127,000 persons (including substantial proportions of Blacks and Hispanics) had been added to the census as a result of the program. Of these, about 82,000 were persons whose names were on the NHHS lists, and 45,000 were persons whose names did not appear on the lists but who resided at listed addresses and were enumerated as part of the NHHS followup. These persons represented approximately 1.2 and 0.7 percent, respectively, of the 6.8 million included in the NHHS lists. This resulted in a total yield of about 1.9 percent of the NHHS lists—substantially lower than the 10 percent test experiences had predicted. The evaluation also indicated that another 58,000 persons should have been added, but were not, for reasons probably attributable to the timing of the operation—late in processing, when pressures were greatest to complete work and close the offices. The lists themselves also were examined; those from public assistance rolls and the Immigration and Naturalization Service yielded almost twice as many adds per followup case as those from the motor vehicle departments. The NHHS program's field processing cost was estimated at \$6.3 million, or about \$35 per person added in centralized areas and \$73 per person added in decentralized areas. (PERM 99)

Followup of vacant and deleted housing units—As part of the 1980 census, all known housing units classified by census enumerators as "vacant" or "deleted [as nonexistent]" were revisited to determine if they had been correctly classified. The initial classification of housing units as vacant or deleted varied, depending on the type of census procedure under which the housing unit was enumerated. In the mail census areas, most persons were enumerated by being mailed a questionnaire that they were to fill out and mail back. For addresses for which no questionnaire was returned, enumerators were sent to determine if the housing units were occupied on Census Day, and to complete questionnaires for both occupied and vacant units. Under the conventional door-to-door list-and-enumerate census procedures, enumerators classified housing units as occupied or vacant as they visited and enumerated them. For both mail or conventional procedures, all vacant (but not vacant usual-home-elsewhere) units were routinely rechecked through a field followup. (See ch. 5.)

Analysis showed that this field followup covered some 5.8 million vacant and 2.3 million deleted housing units. As a result of the followup, about 10 percent of the vacant units and about 7.5 percent of the deleted units were converted to occupied. The followup operation's cost, about \$36.3 million (mainly for field work), was the largest of all the coverage-improvement programs. (PHC80-E3)

Prelist recanvass—This operation was in response to concerns about address list completeness in prelist areas. The objectives were to add and enumerate housing units that had been missed, to reinstate deleted listings where appropriate, and to eliminate duplicate listings. Prelist recanvass was conducted in 137 district offices. (See ch. 5.)

Evaluation was based on a clerical review of a sample of the recanvass registers. Clerks compared the sample of address registers the field enumerators had used for the recanvass with the master address registers (MAR's) to see how many units the procedure had added; then they checked the MAR's for units reinstated or deleted through the recanvass. For the areas covered by the evaluation, it appeared that about 105,000 housing units (0.8 percent of the census count) had been added by recanvass, and that these units contained an estimated 217,000 persons. The recanvass operation cost \$10.29 million. (PHC80-E3)

Assistance centers—To aid respondents in completing questionnaires, and in directing persons who had not been enumerated in how to be counted, the Census Bureau established walk-in assistance centers in each of the 87 centralized district offices and offered telephone assistance from all 373 centralized and decentralized offices. All of the mail questionnaire address labels carried a telephone assistance number, which was also published through the media and public organizations.

Staffing was by specially trained clerical personnel whose tasks included providing answers to questions from the public, arranging for enumerator visits when necessary, and recording assistance requests. If clerks determined that a person had not been counted, a questionnaire was completed and returned to the census district office. A matching operation took place there to see if a questionnaire already existed for the person reported to have been missed. Those not found by this search were added to the census. (See ch. 5.)

A complete evaluation of assistance centers did not prove possible as some of the needed records were not retained. However, a sample of the extant records was reviewed; this indicated there had been around 790,000 contacts, mainly among the decentralized offices, and most often concerning whom to list on the household roster or how to report monthly rent. The program cost was estimated at slightly over \$2 million. (PERM 102)

Spanish-language questionnaire—The goal of this study was to evaluate the alternative methods used to furnish Spanish-language questionnaires to respondents. The Spanish-language questionnaire option in 1980 was communicated to the public primarily via the standard census questionnaire.

In mailout/mailback census areas, respondents could request a questionnaire in Spanish in one of three ways. The first was by checking a box on the cover of the English-language version (indicated by an instruction in Spanish) and mailing it back. The second was by calling the assistance center number appearing on the address label, and the third was by requesting one from the nonresponse followup enumerator if the householder had not returned the questionnaire to the district office. In conventional (nonmail) areas, it also was possible to obtain the appropriate questionnaire (or an interview in Spanish) when the enumerator called at the household. (See ch. 5.)

The effectiveness of asking respondents to request Spanish-language questionnaires by marking the cover of the English questionnaire was evaluated through data collected for several other small-scale studies. These data indicated that very few Spanish-language questionnaires were obtained this way. Enumerators did not keep records on the number they supplied during followup, so the frequency with which this method was used could not be evaluated. There was evidence from the walk-in assistance centers that about 19 percent of the questionnaires asked for there were in Spanish. (PERM 90)

"Were You Counted?" (WYC) campaign—The WYC publicity campaign was designed to enumerate persons who claimed to have been missed in the census. At the conclusion of the regular enumeration, WYC forms containing basic population questions translated into various languages were sent to urban newspapers to be published as a public service. Respondents were asked to complete these WYC forms if they believed they or any members of their family had not been enumerated. For persons who responded, the forms were matched to the census records, and those persons not found were added. (See chs. 4 and 5.)

Evaluation involved reviewing a sample of district office materials. This review led to an estimate of about 62,000 forms received nationally, with reports of about 140,000 persons. About half the persons were added to the census; roughly another quarter were found to have been enumerated already, and the fourth quarter were not added for various reasons (such as a poor or unlocatable address). Some 4,000 of the added persons appeared to have been duplicated as a result of adding them from the WYC operation. Census office processing was estimated to have cost \$270,000. (PHC80-E3)

Post-enumeration post office check (PEPOC)—This check was designed to improve census coverage through a postal review in those areas where the traditional door-to-door, list-and-enumerate (conventional) procedure was used. After the enumeration was completed, the Postal Service reviewed the

addresses that had been collected. Local post offices identified some 148,000 housing units that the census might have missed. The Census Bureau's followup added both housing units and persons to the census from this operation. (See ch. 5.)

An evaluation of the PEPOC records from a sample of district offices indicated that about 50,000 housing units (0.68 percent of all units in conventional census areas) and approximately 130,000 persons were added to the census through this operation. Evaluation estimated the cost at about \$990,000. (PHC80-E3)

Local review—This program involved having each district office send to local officials for review preliminary census counts of population and housing units (occupied and vacant), down to the enumeration-district (ED) level, after the nonresponse followup operation had been completed. The officials were to review these counts and notify the district offices of discrepancies for which they had "hard" evidence, and the district office staff would investigate and resolve these cases. About a third of the 39,000 governmental units that had been contacted participated in the program, and half of these participants identified potential problems. (See ch. 5.)

Evaluation was conducted by summarizing all the materials and records saved from the program. This indicated that problems had been identified in about 28,000 ED's, and these were resolved in about 20,000 cases without a recanvass. Recanvassing corrected the geographic codes for about 28,000 housing units, and added 53,000 units and nearly 76,000 persons to the census. The local review program was estimated to have cost around \$4.3 million, the major part of which (\$2.7 million) was spent on generating the preliminary population and housing counts for local officials to review. (PHC80-E3)

CONTENT EVALUATION

Content evaluation studies focused on the potential nonsampling error and bias in the census data in terms of reporting accuracy or consistency, the impact of collection and processing procedures on the data, and the measurement of this error's components. The studies were based on reinterview procedures, matches of census files with other independent sources, and contrasts between certain census totals. They also were designed to identify characteristics with high degrees of nonsampling error or bias.

Content Reinterview Study

This study was designed to measure the simple response variance and response bias associated with certain population and housing data in the 1980 census, and thus provide information on the quality of the data. The questions selected for the study generally were those that were new or substantially changed for 1980, or where evaluation in past censuses or tests

indicated the need for repeated measurement. The population questions were: Spanish/Hispanic origin, school attendance, place of birth, citizenship, year of immigration (to the United States), non-English language spoken and ability to speak English, and ancestry. The first item was tested with the same question as in the census (to measure response variance), and the rest with differently worded questions (to assess response bias). The housing characteristics analyzed were: tenure, heating fuel, property size, condominium status, seasonal vacancy status, property usage, number of vans or trucks, year structure built, heating method, units in structure, number of automobiles, and plumbing facilities. Here, the first six items repeated the census questions and the last six, the differently worded questions. (See ch. 12 for facsimiles and discussion of the individual census items.)

The study sample was designed to be self weighting, with 14,000 housing units, all of which had received long-form questionnaires. Staff interviewers from the Census Bureau's Current Population Survey, given 2 days of special training for this study, visited the sample units between November 1980 and January 1981. Where possible, they contacted each person 15 years of age and older as self-respondents, and collected data for younger persons by proxy. Fifteen- and 16-year-olds could be interviewed either as self-respondents or by proxy. Telephone and proxy interviews for persons over 16 were permitted only as a last resort. The interviewers completed household rosters and reinterview questionnaires for the households at the time of the original contact, without any knowledge of the responses originally made in the census. The completed questionnaires were reviewed in the Census Bureau regional offices, followed up if necessary, and then sent to the decennial census processing offices for check-in and temporary storage. Of the 13,764 reinterview cases accounted for, 88 percent resulted in completed questionnaires.

Processing took place in Jeffersonville, IN. Here, the reinterview questionnaires were coded, edited, and linked with the census questionnaires under strict quality controls. Of the 12,313 cases from occupied units, 9,953 (81 percent) were matched. The linking data and the data from the reinterview questionnaires were keyed. The reinterview data were matched to the census sample detail files to create a file of reinterview data and corresponding census data. This file was used to produce the reinterview tables and statistical measures of response variance and bias.

Allowing for changes in the time lapse between Census Day (April 1, 1980) and the reinterviews (November 1980-January 1981) and the effects of field collection and subsequent processing, census data imputation, movers, and the like, the study (using both edited and unedited questionnaires) arrived at a number of conclusions:

Among the population items, Spanish origin yielded a low level of response variability.

The school-attendance characteristic showed that the highest-grade attended item exhibited a moderate level of response

variability. Two of its eight college categories exhibited an upward bias, while three had a downward bias. The item asking whether the person finished the highest grade (or year) of school attended reflected a downward bias in the "Yes" category that could have been a result of the time lapse between the two responses and therefore not a true instance of under-reporting. Most of the misreporting occurred in categories past grade 10, with more education generally reported during the reinterview. On whether the person attended regular school or college at any time since Feb. 1, 1980, it appeared that persons not working toward a degree were much less likely to report school attendance than persons who were.

The place-of-birth characteristic exhibited a low level of response variability, with only the District of Columbia and Idaho showing moderate levels. About a third of this misreporting for the District reflected the tendency to report the actual place of birth (a District hospital) rather than the mother's adjoining State of residence (Maryland or Virginia), as instructed in the place-of-birth question. In more than half of the cases where Idaho was misreported in the census, the "correct" response should have been Illinois or Indiana, suggesting a coding/handwriting problem rather than a respondent's conceptual error for that category. The unedited data showed bias for six States and "Other." Misreporting for these categories appeared due to census responses of "U.S." and "Other." During editing, "U.S." was removed and many "Other" responses were changed to the "correct" State. As a result, the edited data showed no bias. (See below.)

The unedited citizenship data exhibited high variability, but low variability when edited. The cause of the high inconsistency before editing was many respondents' failure to skip the two citizenship questions if they were born in the United States.

The question asking whether a person spoke a language other than English at home had a moderate level of response variability with some upward bias in the "Yes" category. The question asking for the specific non-English language spoken yielded very low response variability. None of its categories showed any significant bias.

Overall, the ancestry characteristic had a moderate level of response variability: The most frequent confusion appeared in the ancestry pairs English/German, English/Irish, and English/Scottish. The most inconsistency was evident where the reinterview response was United States or American, especially when the census response was English, French, German, or Irish. There was an upward bias for the categories English, French, German, Irish, and other single-ancestry groups, while Czechoslovakian, Italian, Russian (except Ukrainian), Scottish, and U.S.-American showed a downward bias.

Among the housing items, tenure and heating fuel exhibited low levels of response variability, while the characteristics of property size, condominium status, and seasonal vacancy showed moderate amounts of variability. The property-size question exhibited high variability inside metropolitan areas. The property-usage characteristic showed a high level of response

variability, most of which was due to a shift from "Yes" in the census to "No" in the reinterview. This could have indicated a misunderstanding of the "commercial establishment" concept used in the census that was clarified during the reinterview. The remaining housing items were evaluated for response bias: The item concerning the number of vans or trucks exhibited some bias in the "None" and "Two" categories. Overall response variability for the questions was in the moderate range. For multiunits, year structure built (given by a structure respondent) showed bias in the three intervals corresponding to the oldest building dates. For single and multiunit structures, the response variability for this characteristic was moderate and at about the same level as in 1970. There was no evidence that people reported the date of extensive remodeling as the original construction date. The heating-method item showed moderate response variability at about the same level as in 1970; most of its categories reflected bias. The units-in-structure item had moderate levels of response variability that increased as the reported size of the building increased, which probably resulted in having units inside metropolitan areas showing more variability than units outside. The census results were upwardly biased for the number-of-automobiles item; its moderate levels of response variability increased with the number reported. The plumbing-facilities item showed a relatively large upward bias in the category "Yes, but used by another household," while the response variability was in the moderate range.

Evaluation of the edited census data, when compared with the reinterview data, led to some general observations: For the most part, analysis revealed that the level of bias seemed to be about the same in the edited and unedited distributions for a particular characteristic. There were a few isolated cases, such as citizenship, where editing appeared to reduce the bias considerably, but this was an exception. In most cases, the index of inconsistency and corresponding confidence intervals computed from the edited census data were larger than the index from the unedited data. (PHC80-E2)

Evaluation of Education Questions

This 1983 study presented descriptive analyses of education-related responses from the census/content reinterview (CRS) matched file of 24,585 persons, emphasizing several key issues—measurement, reliability, and proposed question alternatives. Rigorous statistical tests were not included. The questions examined were highest grade attended, degrees attained, and present enrollment from the census mail questionnaire, and in school or college from the CRS. Inconsistencies were noted among the census/CRS responses, including an upward shift in reporting the highest grade completed. The study suggested that some of the inconsistencies might be attributable to methods or question wording. (PERM 104)

Detailed Evaluation of Place-of-Birth Question

This 1986 study provided a systematic evaluation of the accuracy of reporting place of birth in the 1980 census based on the Content Reinterview Survey (CRS). The study carried

out a much more detailed analysis of the place-of-birth question than a previous study (see above), and more conclusions could be drawn regarding the attributes of the census data on place of birth. The study focused on three types of evaluation: (1) The identification of different types of response errors to the question on place of birth in the 1980 census, (2) the identification of allocation error resulting from the computer assignment of unknown place of birth, and (3) the evaluation of net errors in place-of-birth distributions at the regional and State level.

The results of this report showed that the vast majority of persons correctly reported their place of birth in the 1980 census; however, certain types of response error occurred with varying frequency by age and race. On the basis of the match of census responses with the "correct" CRS response, it was determined that the correct place of birth was reported for 95.0 percent of all persons. Of the 5.0 percent of matched cases where the census State of birth differed from the CRS State, 3.6 percent were attributable to incorrect reporting by respondents. The remaining 1.4 percent were the result of the misallocation of place of birth for nonrespondents in the census. When the results were classified by race, substantial differences in the accuracy of reporting place of birth emerged. The place of birth was estimated to be correct for only 91.7 percent of Black respondents where the estimated response error (5.8 percent) and allocation error (2.5 percent) were almost double the corresponding rates for White-and-other-races respondents. A common mistake for persons of all age and race groups was to report the place where their birth occurred instead of the place where their mother was living. Over 70 percent of persons who were born in a State that differed from their mother's residence misreported the actual State of birth. This extremely high rate of misreporting indicated that persons were probably not reading the questionnaire instruction to report the State of mother's residence or that people simply do not think of the birthplace in terms of their mother's residence when they were born. Finally, for some persons, (especially older Blacks), there was a tendency to report the State of residence or some "other" State as place of birth.

The second phase of the evaluation demonstrated how most of the gross errors in the census data on place of birth tended to cancel when aggregated to distributions by place of birth. Thus, with some exceptions, the Content Reinterview data indicated that published census place-of-birth distributions were accurate. The exceptions were significant biases in the census place-of-birth data for the Black population and, as noted on p. 22 above, for the total population of a few States (Nevada, Idaho, District of Columbia, and Maryland). (PERM 111)

Utility Cost Study

Experience from the 1970 census suggested that respondents' estimates of the average monthly cost of gas and electricity were subject to relatively large response biases (net

overreporting) and that the size of the bias varied considerably from area to area. A record check study was designed to evaluate a proposal that the reporting of electricity and gas costs in the census would be improved if utility companies furnished their customers with statements of their average costs for the 12 months preceding the census. This method was chosen because it was assumed householders would not ordinarily have averaged bills readily available; a probing reinterview therefore would be subject to the same biases as the original census response. (The 1980 census collected utility costs for both renter- and owner-occupied units, whereas the 1970 census included only renters' utilities.)

Of the companies responding to the Census Bureau's December 1979 inquiry and willing to cooperate, 11 companies serving 8 cities (Beaumont, TX, Davenport, IA, Dearborn, MI, Little Rock, AR, Macon, GA, Montgomery, AL, Rockford, IL, and Stockton, CA) actually participated in the study. The companies randomly selected a sample of approximately half of their residential customers, who then were notified of their average monthly utility costs when they received their bills in March 1980. The other half of the customers, who served as the study's control group, were not notified. The companies provided the Census Bureau with their customer lists, which included names, addresses, average monthly utility cost, number of months on which the average was based, and indicated whether the customer was either in the sample or the control.

The actual costs incurred were compared in 1982 with the amounts the same households reported on the 1980 long-form household questionnaires. Analysis for the eight cities revealed that, overall, the census respondents tended to overreport their gas costs more than they did their electricity costs. Also, renter-occupied households tended to overreport both costs more than their owner-occupied counterparts. For electricity, the improvement resulting from the notification was 22.6 percent for renters and 38.0 percent for owners, but the notified census respondents still overreported their costs by 15.2 percent (owners) and 26.0 percent (renters). For gas, the improvement was 26.7 percent (renters) and 48.4 percent (owners), but the notified census respondents still overreported their costs by 41.2 percent (renters) and 29.7 percent (owners). Mortgaged households reported electricity costs more accurately than nonmortgaged ones, but there was only a slight difference when reporting gas costs. Providing customers with their average monthly costs for electricity significantly improved estimates of shelter costs in owner-occupied, mortgaged units, with somewhat less improvement reflected in shelter costs for homeowners without mortgages or gross rent for renters. Furnishing customers with their average monthly cost of gas significantly improved both shelter costs for homeowners and gross rent for renters. (PERM 59)

PROCESSING AND QUALITY-CONTROL EVALUATIONS

A number of projects studied various aspects of the data capture and processing system, particularly the effectiveness of quality controls on the operations. Most of the evaluations

dealt with clerical coding, for which written-in responses on the sample household questionnaires were converted to FOSDIC (film optical sensing device for input to computers) codes so the data could be processed electronically. Other evaluation dealt with qualification testing of the coders. The coding operations were classified as general, industry and occupation (I&O), and place of work/migration (POW/Mig). "General" covered all entries other than I&O and POW/Mig, such as for ancestry, income, utility costs, and the like. Coding, qualification, and quality-control methods are described in chapter 6.

Overall evaluation of the three types of coding indicated that production rates in the three processing offices tended to vary more than error rates by a ratio of approximately two to one. Production rates tended to vary more than error rates relative to coders within processing offices also by a ratio of approximately two to one. The slower coders tended to do poorer quality work. Contingency-table analysis suggested that there was an overall dependent relationship between error rates and production rates in each of the three coding operations. Production rates generally tended to increase and error rates tended to decrease over the ordered time base. (PERM 77)

General Coding

Qualification testing—For all three processing offices, there was a statistically significant tendency for a general coding clerk who qualified from the first test to produce work with an average error rate below the 1.8 percent level required for acceptable performance. Similarly, a clerk who qualified on the second test tended to produce work at an unacceptable quality level, i.e., with an average error rate greater than 1.8 percent. Within each processing office, the distribution of scores of the first qualification tests most frequently used did not differ significantly from a Gamma distribution. Approximately 4 percent of all prospective general coders failed to qualify for coding. (PERM 78)

Comparison of 100-percent review error rates and quality-control sample estimated error rates—The purpose of this study was to determine if there was a consistent relationship between the estimated error rates for rejected work units and the error rates for the same general-coding work units when "rectified," i.e., underwent 100-percent review and correction. Analysis of the quality-control records for sample verification and rectification found that there was no consistent relationship between the two sets of error rates; sample-verified data had an estimated error rate of about 52 percent, while the same data, when rectified, yielded an error rate of less than 4 percent. (PERM 26)

Verification—This study measured the quality of the verifiers' work in the general-coding operation and determined in a dependent manner its effect on the accuracy of the quality-control accept/reject decisions about individual coders' work.

Population Division technicians in each of the processing offices periodically reviewed a nonstatistical sample of each verifier's work. The study's major findings were that the verifiers' overall miss rate, measured in the nonstatistical sample, was 36 percent. Their omission rate was 33 percent and their commission rate, 0.07 percent. The rates varied within and between the three processing offices, with New Orleans having consistently higher rates than Laguna Niguel and Jeffersonville. (The "omission rate" was defined as the percentage of all incorrect codes before postcoding that still were incorrect after postcoding; the "commission rate" was the percentage of all correct codes before postcoding that were incorrect after postcoding.) (PERM 47)

Income-item coding—"Factors of 10" errors—These errors resulted when general coders inadvertently shifted the decimal place in income responses to the left or to the right—i.e., by a factor of 10. These items included wages and salary, nonfarm and farm income, interest, dividends, social security, retirement, and other income sources. Prior to this study, relationship and consistency computer edits were employed to identify ED's having significant error rates in income data and to correct the codes. (For discussion, see ch. 12, p. 27, n. 14.)

Data for this study were obtained from the processing center coding performance (PCCP) evaluation (see below). It appeared that production coders, on the average, erroneously coded the eight income items 5.1 percent of the time. This ranged from a low of 3.8 percent for wages and salary to a high of 13.6 percent for nonfarm income. Approximately 15 percent of all income-item errors were of the factor-of-10 type, but correction of those identified in the study involved only 2.5 percent of those estimated to exist in the census. (PERM 73)

Industry and Occupation (I&O) Coding

Qualification testing—For all three processing offices, a statistically significant tendency was found for clerks who passed the first qualification test to have a cumulative error rate below the acceptable performance level (8.25 percent). It also was shown that those failing the first test tended to code above the acceptable performance level. Over all, 2 percent of the clerks at the Jeffersonville processing office failed to qualify for coding, 12 percent at Laguna Niguel, and 8 percent at New Orleans. (PERM 29)

100-percent rectification—This study was designed to determine if there was a consistent relationship between the estimated error rates for work rejected in I&O coding and the error rates for the same work when it was 100-percent rectified. Analysis of the quality-assurance records showed that there was no consistent relationship between the two sets of error rates, and that the sample-verified data had an estimated error rate of roughly 46 percent, while the same data, when rectified, yielded an error rate of about 22 percent. (PERM 34)

Postcoding—This study evaluated the quality of the I&O postcoders' work, of which Population Division technicians reviewed a 1-in-5 nonstatistical sample. The study concluded that across all processing offices, (1) the measured postcoder omission rate was 32.0 percent, (2) the measured commission rate was 1.0 percent, and (3) the measured overall miss rate was 21.0 percent. (PERM 57)

Puerto Rico and outlying areas—This study was designed to assess the quality of these areas' I&O coding through a two-way independent quality-assurance scheme with dependent postcoding of differences. Rejected work units were 100-percent rectified if the estimated error rate was greater than 30 percent. The study found that the item error rate was 8.5 percent for Puerto Rico and 7.9 percent for the outlying areas. Both rates were somewhat higher than the 7.5 percent estimated for the 50 States and the District of Columbia. (PERM 37)

Place-of-Work/Migration (POW/Mig) Coding

Qualification testing—Analysis of data from the Laguna Niguel and Jeffersonville processing offices showed that qualifying on the first test was associated with cumulative coding error rates lower than the acceptable performance level (5.25 percent), while qualifying on the second test was associated with cumulative production coding error rates higher than the acceptable performance level. Approximately 4 percent of all prospective coders failed to qualify for coding. Analysis excluded data from New Orleans. (PERM 88)

Postcoding—The purpose of one evaluation was to determine the quality of POW/Mig postcoders' work. Population Division technicians reviewed one-fifth of it each day. Analysis of a nonstatistical sample of the reviewed work indicated that across all three processing offices, the postcoders' miss rate was about 25 percent, the omission rate about 19 percent, and the commission rate 0.4 percent. (All numbers were approximate.) (PERM 36)

The staff also took a nonstatistical sample of ED's that had undergone the 100-percent dependent review required of "very poor quality" POW/Mig coding (i.e., where the sample estimated error rate exceeded 30 percent). Quality-control sample data were compared with the sample of independent postcoding data for the sampled ED's. Results indicated that sample quality control, using independent postcoding, tended to charge twice the error rate (40.1 percent) found in dependent review (19.2 percent). (PERM 30)

Processing Center Coding

The purpose of this evaluation was to estimate the quality of each clerically assigned code for the general, I&O, and POW/Mig coding operations. A selfweighted sample of enumeration

districts (ED's) was selected across the three processing offices and two questionnaires were chosen at random from each ED. Three copies were made of each questionnaire, with the codes masked. Each copy was coded independently to a FOSDIC form for each type of coding, so there were three sets of codes assigned to each questionnaire's general, I&O, and POW/Mig responses. The FOSDIC system captured the independently coded data. The codes then were matched by computer, which selected the majority code of each set of three as the correct one. The correct code then was compared to the original (production) code on the original sampled questionnaire. The evaluation's major findings were as follows: On a national basis, general coding had an error rate of 2.6 percent; I&O coding, 11.7 percent; and POW/Mig coding, 9.3 percent. The Jeffersonville facility produced significantly better quality coding than either Laguna Niguel or New Orleans. The estimated outgoing error rates for each 1980 coding operation were higher than they were for 1970. The dependent verifier "miss rate" for general coding was comparable to that for independent I&O and POW/Mig postcoders. (PERM 68)

Linear relationship among time, production, and quality—This study compared clerical coding (1) production rate vs. time, (2) error rate vs. time, and (3) item-error rate vs. production rate among the three 1980 census processing offices. Regression and correlation analysis of the quality-control data for various months found that general and I&O coding improved in quality across all offices during both early and late stages of coding, although less rapidly during the latter. This was not true of POW/Mig coding, possibly because each SMSA coded required a new, small learning curve. Some of the regression slopes differed significantly among the offices. (PERM 39)

Item-error rate distributions—This study provided comparisons of coding item-error rates on a work-unit basis for general, I&O, and POW/Mig coding operations among the three 1980 census processing offices. Review and analysis of each office's quality-control records indicated that the Jeffersonville office's mean work-unit item-error rate was significantly lower than the other two for all three coding operations, and Laguna Niguel had a significantly lower mean rate than New Orleans. The item-error rate distributions among the three offices differed significantly. (PERM 38)

A second study was designed to determine whether the data from the three major coding operations (general, I&O, and POW/Mig) in the 1980 census processing offices fit certain statistical distributions. The data studied were the number of items coded per questionnaire and the coding-error rate per questionnaire. The study found that no data fit the normal distribution function. Two of the three processing offices (Jeffersonville and Laguna Niguel) appeared to have a Gamma

distribution of the number of POW/Mig items coded per questionnaire, and one of the three offices (Jeffersonville) also appeared to have a Beta distribution for the same data set. (PERM 103)

Other Processing Office Operations

Quality-control management information system (QCMIS)—The purpose of this study was to analyze the effectiveness and timeliness of the data coming through the QCMIS (see ch. 6) concerning the three major coding operations. The major findings were that (1) the QCMIS was effective as a major data-gathering agent, and (2) the processing office and headquarters staff used its output in decision-making, but (3) its effectiveness was hampered by problems in getting the data into the system, such as late delivery of records and lax verification of keying, and in computer processing, specifically, weighting the data. (PERM 40)

Content reinterview study (CRS): clerical operations—During the CRS (see p. 21), if it was discovered that one or more persons in the sample household had been living somewhere else on Census Day, the interviewer completed a CRS form for each unique Census Day address. This form then was used to match the reinterview person(s) to the appropriate census questionnaire(s). Specific items were coded and keyed on both the original and reinterview questionnaires. This study measured the accuracy of these matching and coding operations by reviewing close to 10,000 CRS questionnaires and 250 alternative-address records with their corresponding census questionnaires. The match/transcription item-error rate for the CRS questionnaires was 0.35 percent and for the alternative-address records, 0.46 percent; the coding item-error rates were about 0.44 percent for both types of forms; and the estimated field-keying error rates for the two types of forms were 0.18 and 0.09, respectively. (PERM 43)

GBF/DIME File Closeout Evaluation

This was an independent study that evaluated the geocoding of 280 GBF/DIME (geographic base file/dual independent map encoding; see ch. 3) files by estimating the accuracy of the ZIP Code, block, census tract, and place codes prior to census geocoding. A sample of about 600 to 800 housing-unit addresses over 5 strata were selected from each file; address cards were prepared for them and sent to the appropriate regional offices for field listing. The address cards then had their geographic codes compared with the corresponding codes from the GBF/DIME files. A geographic planning specialist in each region adjudicated differences. The errors were weighted by stratum and an estimate of the quality of each file was calculated. The results were as follows: (1) The national error rate estimates on an address basis for block/tract/place/ZIP was 6.0 percent, and

for block/tract, 3.8 percent. (2) Using a predefined goal of a block/tract error rate of 5.0 percent or less, 79.3 percent of the files passed the closeout evaluation. (3) The 1980 GBF/DIME files' national estimated block/tract/place error rate was lower than the one for the 1970 address coding guides (ACG's) for which block, tract, and MCD/CCD (minor civil division/census county division)/place error rates were computed; the 1980 ACG estimated rate was 4.9 percent, compared with 1970, 6.9 percent. (PERM 49)

OTHER STUDIES

Census Logistical Early Warning Sample (CLEWS)

Approximately 6,000 of the regular 1980 census household questionnaire mailing packages chosen from a national sample (3,000 short and 3,000 long forms) were prepared with return envelopes marked "CLEWS" and addressed to the Jeffersonville processing center instead of the appropriate district office. As the completed questionnaires were received in Jeffersonville each day, they were immediately checked against a control list, edited, coded, and reviewed before being copied and forwarded to their respective district offices for inclusion in the census. The review was translated into rapid estimates of daily mail-return rates and questionnaire edit-failure rates by type of district office (centralized or decentralized) and type of form (long or short). CLEWS served as an early warning about the amount of work to expect, the CLEWS questionnaire copies also served as the control group for the alternative questionnaire experiment (see below).

The staff was able to analyze 5,142 CLEWS cases and confirmed after the census that their return rates resembled those being experienced in the district offices, and with little difference between long and short forms. The race, Spanish-origin, and income responses required the most editing and/or followup. (PERM 22, 46)

Imputation, Allocation, and Substitution

In the census, these three methods dealt with the assignment of information, based on related data, for unreported items (e.g., housing, persons, or both) on a questionnaire. Despite extensive efforts to obtain complete data, it was not always possible to do so, due to factors such as partial enumeration, respondent refusal, coding error, and/or electronic processing. The Census Bureau chose to impute missing data so that records would be complete for tabulation.

A series of procedures were designed to deal with varying amounts of incomplete data, resulting in a "continuum of [data] completeness" ranging from totally complete forms to

those in which the occupancy status and/or household size were not known. These procedures are described in chapter 12 and their evaluations are highlighted below.

Imputation in the 1980 census—Examination of the records indicated that of the total U.S. population, 10.5 percent required the imputation of one or more—but not all—characteristics. Approximately 1.2 percent had all their characteristics substituted from other households, based on a known household size. An additional 0.3 percent of the population had all their characteristics imputed by substitution based on an imputed household size and, in some instances, an imputed occupancy status. It was this 0.3 percent of the population that led to a lawsuit the State of Indiana brought against the Census Bureau, charging that imputation had cost the State a congressional seat. (See ch. 10.) (PERM 32)

Special check on unclassified units—As the district offices were closing, field verification was undertaken in 12 areas with the highest rates of unclassified housing units (i.e., those lacking [1] household size or [2] vacancy status and household size), using a purposive sample. Within the 12 district offices, enumeration districts (ED's) with 50 or more such units were included, and about 11,000 units were checked. There was some concern that these might be seasonal vacant units, and therefore would have had more than their share of persons imputed. The results showed that the majority of the unclassified housing units represented year-round occupied units, thus alleviating the concern. (PERM 10, 32)

Run length—Data from earlier censuses showed that units that are close together are more similar than those farther apart, and that adjacent units are better predictors of household size than other units from a larger area. An investigation after the 1980 census determined how often during census processing an adjacent unit (defined as the immediately preceding unit on the basic record tape) was used as the donor unit for imputation. The "distance" between two units was to be measured by the number of questionnaires separating the donor and the imputed unit. As this information was not readily available, the data-capture files for the States of Florida and Alabama were rerun through the imputation program. A major portion of the imputations (70 percent in Florida and 78 percent in Alabama) were drawn from the preceding unit on the data tape.

To separately identify the "hot deck" imputations in which both occupancy status and total population were imputed and those in which only total population was imputed, an additional study was carried out on nine ED's. The microfilm for these ED's was rerun, and the data-capture program was altered to obtain the occupancy status and household size of the housing units subject to imputation. (Other than for these nine ED's, the data for the imputed units with a known vs. allocated occupancy status were not available.) In 50 percent of the housing

units for which the total population was imputed, both occupancy status and total population were imputed; in the other 50 percent, only total population was imputed. The evaluation found that over 60 percent of the units subject to imputation received data from the preceding unit (67 percent for units requiring imputation of both occupancy status and total population). With regard to vacancy rates, there was no statistically significant difference between units with known occupancy status and those with allocated occupancy status with regard to the proportion vacant. (PERM 32)

Intraclass correlation—This study measured the degree of homogeneity within housing clusters by computing intraclass correlation coefficients for various 100-percent population and housing characteristics from a 10,000-ED sample of different-sized clusters, widely distributed in their geography. (The sample comprised the ED's chosen in the second stage of 1980 PEP E-sample selection [see p. 8 above].) Past studies had indicated that small clusters exhibited a higher degree of homogeneity than larger ones—i.e., units that are closer together are more similar than those farther apart. This finding of homogeneity supported the use of an adjacent unit as a donor during imputation. The results of this study showed that as cluster sizes increased, intraclass correlations decreased, confirming the trend. (Another application of these results was in survey design, as this homogeneity produced an increase in sampling variance.) This study provided tables showing the statistical effects of clustering at various sizes and different geographic disaggregations, and demonstrated that various sample designs should be considered in choosing the most cost-effective methodology. (PERM 69)

Other Evaluations

Estimation procedure for 1980 census sample data—To determine an estimation procedure for weighting the 1980 census sample, this project investigated a number of proposed methods. The estimators were of three basic types: (1) Raking ratio, (2) post-stratified or cell-by-cell, and (3) the inflated sample mean or "single cell." The staff created a study universe from the 1970 census sample records and divided it into weighting areas. In each weighting area, all possible samples were obtained according to the anticipated 1980 census sampling scheme. The records for each study population sample were weighted, utilizing each of the proposed estimation methods. For each method, the actual standard error, bias, and mean square error were calculated for a variety of data items, based on all possible samples within each weighting area. These statistics formed the basis for comparing the proposed estimation methods.

Considering standard error, bias, and sampling biases occurring in a census, the staff felt that a raking-ratio procedure would be the most desirable, as it would control to some extent

for sample biases and also provide adequate estimates for various demographic totals. The best of the raking-ratio procedures examined was selected for use in 1980.

Variance estimation procedure for 1980 census sample data—This project examined the technical and cost-related considerations of four variance estimating methods, employing an extensive empirical analysis to compare them: (1) Random groups, with and without reweighting, (2) jackknife, (3) balanced repeated-replications method, and (4) a linearization technique based on a Taylor-series expansion of the census raking-ratio estimator. Several variations of each basic method were run on one or more populations derived from the 1970 census sample. For each estimator studied, its total mean square error, variance, bias, and cost were derived. The general methodology for the comparison was to structure the study population into all possible samples that would have resulted under the 1980 census sample design. The proposed variance-estimation procedures were performed independently for each sample.

Production for about 1,000 data items to be tabulated from 1980 census sample data was estimated to cost between \$750,000 and \$1 million for linearization, or \$40,000 to \$90,000 for random groups. Balanced repeated replications and the jackknife method were at the high end of the cost scale. The subsequent decision to use the random-groups procedure to produce the census variance estimates was based on both cost and reliability considerations. The findings indicated that the linearization method was superior (almost entirely due to its smaller variance), but at a substantially higher cost. The random-groups method was superior to the balanced-repeated-replications and jackknife methods. (PERM 62)

Estimating upper and lower bounds on census nonsampling variance—This study explored methods for estimating total census variance in ways that did not require experimental designs or reinterview surveys. (Studies had evaluated census operations such as interviewing, coding, editing, keying, micro-filming, and tabulating. The methods most often used for evaluation required either some form of replication of the operation or interpenetration of the operators' assignments. For large-scale surveys, these methods were expensive to implement and difficult to control.) By taking advantage of the census's complete geographic coverage, the estimation method was aimed at producing a narrow range of error that contained the census's total nonsampling variance. The upper and lower bounds would serve as indicators of census data quality. The staff expected that the bounds' utility could be extended to other topics, such as determining which census items were most affected by processing error, comparing a decentralized data-collection procedure with a centralized one, and forming rough estimates of the total census variance.

The idea behind this methodology was similar to the collapsed-strata concept of variance estimation. The effects of the respondent and the enumerator, and the joint effects of the census

district offices' (DO's) and processing centers' operations were to be estimated by functions of three contrasts: (1) Between ED's within the same district, (2) between ED's from several districts processed in the same processing centers, and (3) between ED's within different districts and different processing centers. A sample of centralized and decentralized pairs of contiguous DO's were selected from the Boston and New York census regions and the neighbors for the ED's were identified clerically, so there were 7 DO pairs and 794 ED's for computing centralized estimates and 16 DO pairs and 1,476 ED's for the decentralized estimates. Although inconclusive, the results showed a substantial spatial correlation between neighboring ED's for some characteristics. (PERM 95; Biemer, 1986)

Public Information Evaluation

Advertising media evaluations—To help stimulate public participation and response to the census, public-service advertising materials were distributed in January and February 1980 to over 20,000 media outlets, which were asked to use them on a nonpaid, public-service basis. (See ch. 4.) Among the campaign's primary purposes were (1) giving notice to the American public that a census was to be taken; (2) informing the people how and why they were to be counted; (3) fostering favorable attitudes toward the census and census-taking; (4) eliciting the appropriate cooperative response to the census; and (5) aiding in reducing the undercount, particularly of minority and other hard-to-reach populations. The media (including Black and Spanish language) were local and network radio and television, newspapers (daily and weekly), consumer and trade magazines, billboards, and transit cards.

For two of the evaluations assessing the impact of the public information campaign, the Advertising Council retained independent professional media firms in the summer and fall of 1980 on the Census Bureau's behalf to audit and report on the value of this public-service advertising in terms of audience analyses and dollar value for equivalent commercial advertising. A separate audit was undertaken for the Black and Spanish-language media.

Audience analyses used the measures of "reach" and "frequency" common in advertising research. "Reach" was defined as the number of different adults, 18 years of age or older, exposed to a 1980 census advertising message at least once, expressed as a percentage of the total U.S. population of the same age group. "Frequency" was defined as the average number of times adults, 18 years and older, were exposed to the messages. A variety of standard advertising-research methods, including the use of secondary sources such as Nielsen surveys and market-coverage analysis, were employed to obtain the estimates for each of the 12 media categories. In addition, over 1,000 telephone interviews were conducted. The audit of minority media (largely radio and television) emphasized qualitative as well as quantitative data, documenting the salient character of the ads themselves. Dollar values were compared with those of leading commercial advertisers.

The auditors concluded that the Census Bureau had received the equivalent of some \$38 million worth of commercial advertising, and that virtually every person in the United States had been exposed to an average of 100 census advertising messages from one medium source or another between January and June 1980. This was considered to have reached the "saturation level." The dollar value of the advertising for the 6-month time period placed the census between the second and third largest commercial advertising outlays. Black media accounted for roughly \$0.5 million of the value, and Spanish-language media, \$3.7 million. (The general media also reached Black and Hispanic audiences.)

Predominantly minority radio stations (59 Black and 18 Hispanic) in 18 major cities were contacted by mail, telephone, and personal followup where necessary in the fall of 1980. Of the 77 sampled, 70 responded. All had carried public-service announcements, 50 percent covered the census in talk shows, and somewhat lesser percentages were distributed among news stories, guest interviews, "disk jockey" references, call-in shows, and editorials. (PERM 17)

Knowledge, attitudes, and practices (KAP) survey—The KAP had as its primary goal evaluation of the media campaign's penetration and effect among all segments of the population, in particular, the impact on knowledge of, attitudes toward, and cooperation with the census. Research prior to 1980 had suggested that cooperation with the census might be inhibited by a lack of understanding of what the census is all about: "Who is asking all these questions? Why do they want to know? What are they going to do with my answers?" The KAP survey included six items designed to test knowledge of the basic census facts, including such topics as how often it is taken, who is responsible, the confidentiality of individual replies, whether response to the census is voluntary or mandatory, and its uses for reapportionment and redistricting. Attitude items were intended to sample a wide range of potential concerns, including perceptions about the general importance of the census, its likely beneficiaries, motivation to cooperate, confidentiality, and the usefulness of the census. There were also questions about the specific media and other sources through which respondents learned about the census.

The project employed a pre/post-survey design, with an accompanying record check. The "pre" (phase 1) interviews occurred in late January and early February 1980, before any major buildup of the public-information campaign. The "post" (phase 2) interviews took place about 2 months later, in late March, at the approximate peak of campaign activity. Households were included in either the phase-1 or phase-2 sample, but not both. To minimize response bias (but at the risk of increased nonresponse), an outside contractor conducted all the interviews. At the conclusion of the census, households selected for the phase-2 sample were matched to census records, so that behavior in the census (i.e., mail return,

enumerator assistance, nonresponse) could be assessed objectively. This design permitted analysis of the effectiveness of the public-information campaign in meeting its basic goals.

A multistage, national area probability sample of 50 primary sampling units (PSU's) was employed, with the dwelling unit as the ultimate sampling element. All U.S. areas enumerated by mail were included in the sample frame. To ensure adequate Black and Hispanic representation, these subpopulations were oversampled. Sampling was identical for phases 1 and 2 down to the block level; within a selected block (or its counterpart outside metropolitan areas), the staff designed nonoverlapping clusters of dwelling units for interview in either phase.

Interviews were either in person or by telephone, with one respondent per household—ideally the male or female householder. Phase-1 interviews took place from January 25 through February 6, 1980; out of 3,772 eligible units, there were 2,431 successful interviews (64 percent). Phase 2 was carried out from March 22 through March 27, 1980. Over this 6-day period, 2,446 interviews were completed in 3,115 eligible dwelling units, for a response rate of 79 percent. The phase-2 records were matched to the census with 85 percent success. The survey data were analyzed by race/ethnicity, household income, interview timing, and a variety of outcome variables, and were weighted to approximate distributions of the population.

In terms of reaching people with census messages, the 1980 public information campaign appeared to have been successful. Awareness of the census was already very high (over 90 percent in almost all segments of the population) before the campaign began, yet there were marked increases between phase 1 and phase 2. Based on the survey results, about 3.5 million more households had heard about the census in late March than had 2 months earlier.

Despite the appearance of larger gains among low-income and non-White households in the proportion who had ever heard of the census, statistical analysis detected no differences by race/ethnicity or income in the extent of change. Thus, there had been no reduction of the advantage in awareness that White and high-income households had before the campaign began. Regardless of income, significantly greater proportions of Black and Hispanic households received their census forms without having heard of the census before. Similarly, regardless of race/ethnicity, lower-income households were significantly more likely than those with higher incomes to have received a questionnaire before hearing or reading about the census. These differences were quite small in absolute terms, however.

"Recent" exposure to census information showed a dramatic increase, from about 40 percent of all households in phase 1 to 75 percent in phase 2. This shift was particularly pronounced for Hispanic households, among whom reported recent awareness more than tripled. For all groups, however, the change in recent awareness between phases was positive and highly significant. Among low-income households, the

campaign appeared to have been less effective in reaching Blacks as opposed to Whites or Hispanics; however, there were no detectable differences by race/ethnicity among middle- and high-income households.

The survey also examined the performance of seven specific information channels—newspapers, magazines, television, radio, community meetings, posters and signs, and informal conversation. Virtually every medium reflected positive results, with the greatest relative change taking place in lower-income and non-White households. Television was the most frequently cited source of information about the census, followed by radio and newspapers, for all groups.

With regard to knowledge about the census, the KAP survey concluded that in general, factual knowledge was limited, even after substantial public information campaign activity. For example, only about half of all the households were aware on the eve of the census mailout that the responses would be confidential. Only about 15 percent of the respondents could identify the Census Bureau as the agency responsible for the census. There was only scant and inconsistent evidence that the campaign had positive effects on people's attitudes toward the census. With respect to mail response, it appeared that exposure to the campaign had the most positive effect on low-income households. (PERM 31)

Applied Behavior Analysis Study (ABAS)

The objective here was to investigate the dynamics of the mail-response process in order to learn from whom, how, and why nonresponse occurred by comparing the respondents' self-reports about their actions with respect to the census (from the ABAS) with the census data for the same households. More specifically, the matching process was to determine the final census status of the ABAS households to learn whether and how they were counted and if as mail or enumerator returns. The operation did not address the issue of how many persons were counted within the households.

Shortly after Census Day (to minimize loss of memory about participation in the census process but before followup 1 began, current-program interviewers in the Census Bureau's various regions visited a probability sample of approximately 11,000 households selected from the mail address registers clustered in 20 district offices. Long-form and nonresponse cases were purposely overrepresented. The response rate for the survey was 94 percent.

In the ABAS, self-reports of participation were obtained at each of a series of stages that comprised the mail-response process: Receiving a form in the mail, opening the envelope, starting to fill out the form, finishing the form, and mailing it back. The two self-reports of particular interest were the first and the last—whether respondents reported receiving a census form in the mail and if they reported mailing one back. The responses were analyzed by type of dwelling unit (single vs. multiple), since there was a concern that the mail census might be subject to considerable operational error in multiunit structures. According to the survey, 84.0 percent of those interviewed reported they had mailed back their questionnaires—quite close to the 83.3-percent official rate for occupied housing units. Analysis indicated that mail-return rates were highest for Whites, then Blacks, then Hispanics. The higher the income, the more likely the household was to report that the form had been returned. Exposure to census publicity, awareness of a penalty for nonresponse, and district-office type (centralized-/decentralized) all differentiated between mail-return and non-return households. Long-form and short-form households were equally likely to report returning their forms. Nonreceipt was the reason given most for nonreturn, especially among low-income households and those in multiunit structures. Subjective measures of difficulty (e.g., how hard the form looked and how long it might take to fill out) were important in whether filling out began, whereas objective measures (such as form length and household size) were less important. Conversely, the objective measures were more important in whether the form was finished. (PERM 61)

Following the visits, 90.1 percent of the completed interview records were matched to the census questionnaires (7,701 out of 8,550)—by a variety of methods that were themselves analyzed—to see primarily whether the households had been counted as mail returns or enumerator returns. There was no effort to see if everyone in the household had been enumerated. Analysis showed that 97.6 percent of the households reporting in the ABAS that they had not received census questionnaires were, in fact, counted in the census. Two-thirds of these were enumerator returns and a small portion were “last resort” cases. When single-unit vs. multiunit addresses were considered, 96.0 percent of the single-unit ABAS cases reporting nonreceipt of a questionnaire were enumerated, while the comparable figure for multiunit dwellings was 99.5 percent. (PERM 71)

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Appendix 9A. Preliminary Results Memorandums

Appendix 9A. Preliminary Results Memorandums

Assigned number	Date distributed	Prepared by	Subject
1	08/07/80	Sue Miskura	Description of the Series
2	08/13/80	David Whitford	1980 Decennial Census Questionnaire Printing Quality Control—Opacity and Density Measurements
3	11/05/80	Kenneth Merritt	Summary Report of TAR/APOC [tape address register/advance post-office check] Labeling Operation for 1980 Census
4	01/27/81	Amy Morriss	1980 Decennial Census—Census Logistical Early Warning Sample—Final Results—Quality Control—Editing and Coding
5	01/28/81	John Thompson	Preliminary Summary of Results From the 1980 Census Empirical Variance Estimation Study and a Recommendation to Use the Random Groups Method
6	03/13/81	Mark Littman	Some Results of Address Searching Operations in the 1980 Census
7	04/13/81	Angela-Jo Wetzel	1980 Decennial Census Quality Control of the Printing, Coverage, and Labeling for the BC-114 Labels for the Nonhousehold Sources Records, Form D-434—Final Results
8	05/15/81	Jeffrey Moore	Validity of Self-Report Measure of Mail Response Behavior in the Applied Behavior Analysis Survey (ABAS) #1
9	06/01/81	William Mockovak	The Alternative Training Experiment: Design, Development, and Attitudinal Findings
10	06/19/81	Thomas Harahush	Preliminary Results from the Phase 3 Housing Unit Overcount Study
11	07/20/81	Amy Peregoy	1980 Decennial Census—Census Logistical Early Warning Sample—Final Results—Quality Control—Editing and Coding
12	09/15/81	William Mockovak	The Alternative Training Experiment: Analysis of Performance Data, Discussions, and Recommendations
13	07/24/81	Angela-Jo Wetzel	File Closeout Evaluation of the San Juan, Puerto Rico GBF/DIME File—Final Results
14	09/08/81	Angela-Jo Wetzel	Effectiveness/Consistency Study of the Quality Control Operations for the Post Enumeration Program Processing in the 1980 Decennial Census Processing Offices—Final Results
15	11/16/81	Irma Harahush	Outlying Areas ICR's [individual census reports]
16	11/23/81	William Mockovak	Analysis of Mail-Return Rates for the Alternative Questionnaire Experiment
17	09/23/81	Charles Jones	Vitt Media International, Inc., and Media Associates, Inc. Reports on the 1980 Census Publicity Campaign
18	12/07/81	Jeffrey S. Passel Jacob Siegel J. Gregory Robinson	Coverage of the National Population by Age, Sex, and Race in the 1980 Census: Preliminary Estimates by Demographic Analysis

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Assigned number	Date distributed	Prepared by	Subject
19	03/26/82	William Mockovak	Analysis of Item Nonresponse in the Alternative Questionnaires Experiment
20	02/08/82	Charles Kaplan Bette Goodson Maria Urrutia	Evaluation of the Experimental Student Intern Program (ESIP)
21	07/26/82	Debbie Harner	Final Results of the Evaluation of the CPS/IRS [Current Population Survey/Internal Revenue Service] Administrative Records Match
22	02/25/82	Harold Yamauchi	Results From the Census Logistical Early Warning Sample (CLEWS)
23	06/16/82	William Mockovak	Discussion of Major Findings in the Alternative Training Experiment (ATE)
24	04/05/82	Catherine J. Baca	Job Enrichment Study
25	08/23/82	William Mockovak	Analysis of the Effect of Questionnaire Length in Item Non-response
26	08/18/82	Patty Burnett	1980 Decennial Census General Coding Operation Comparison of 100-Percent Review Error Rates and Quality Control Sample Estimated Error Rates
27	08/18/82	Patty Burnett	1980 Decennial Census: Results of Microfilm Duplication
28	08/24/82	Michael Mersch	1980 Decennial Census: Recommendations for Future Censuses with Respect to Quality Control Experiences from 1980
29	04/12/83	Nanette Mack	1980 Decennial Census: Qualification Tests for Industry and Occupation Coding
30	06/18/83	Michael Mersch	1980 Decennial Census: Place-of Work/Migration Coding—100-Percent Review
31	09/28/82	Jeffrey Moore	Evaluating the Public Information Campaign for the 1980 Census—Results of the KAP [knowledge, attitudes, and practices] Survey
32	12/08/82	Debbie Harner Kathryn Thomas	1980 Imputation Background Results and Evaluations
33	01/20/83	Patty Burnett	1980 Decennial Census: Results of Microfilming Operations
34	05/31/83	Nanette Mack	1980 Decennial Census: Industry and Occupation Coding: 100-Percent Rectification
35	12/82	Harold Yamauchi	Additional Results From the Census Logistical Early Warning Sample (CLEWS)
36	05/04/83	Amy [Morriss] Peregoy Janet St. Clair Kenneth Merritt	1980 Decennial Census: Evaluation Place-of-Work/Migration Postcoder Review
37	03/29/83	Nanette Mack Michael Mersch	1980 Decennial Census: Industry and Occupation Coding of Outlying Areas and Puerto Rico Questionnaires
38	01/14/83	Janet St. Clair	Decennial Census: Comparison of Work-Unit Coding Item Error Rate Distributions Across Processing Offices

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Assigned number	Date distributed	Prepared by	Subject
39	01/14/83	Janet St. Clair	1980 Decennial Census Coding: Linear Relationships Between Time, Production, and Quality
40	12/27/82	Janet St. Clair	Evaluation of the Quality Control Management Information System
41	12/30/82	Catharine Burt	Adverse Impact of 1980 Census Nonsupervisory Selection Procedures
42	12/30/82	Barbara H. Lacey Catharine Burt	Content Validity Study of 1980 Field Employee Selection Procedures
43	05/05/83	Kenneth Merritt	Content Reinterview Study: Summarization of Quality Control Data Collected on Specified Clerical Operations
44	02/28/83	James L. O'Brien	Overcount Evaluation: Housing Unit Enumeration Duplication Study—Results
45	02/28/83	James L. O'Brien	Overcount Evaluation: Housing Unit Enumeration Duplication Study—Methodology
46	03/03/83	Harold Yamauchi	Addendum to PERM No. 22, Subject: Results from the Census Logistical Early Warning Sample (CLEWS)
47	06/06/83	Pat Burnett	1980 Decennial Census: General Coding Verifier Results (Ongoing Verifier Evaluation)
48	06/14/83	Danny R. Childers	CPS/Census Retrospective Match Study Interim Report
49	06/18/83	Angela-Jo Wetzel	File Closeout Evaluation of the United States GBF/DIME Files
50	06/20/83	Marlene Altman Amy [Morriss] Peregoy	Mailing Package Assembly and Labeling Operations for the 1980 Census
51	07/13/83	Howard Hogan Danny R. Childers	IRS/Census Direct Match Study Interim Report
52	06/30/83	David Whitford Kathryn Thomas	Post Office Effectiveness
53	07/20/83	Amy [Morriss] Peregoy	Final Results of the QC [quality control] Operations in the Processing offices for the 1980 DC—Housing Unit Coverage Studies
54	07/13/83	Milton Fan	Preliminary Summary of Results from a Comparison of Methods to Present 1980 Census Variance Estimates
55	07/20/83	Kathryn Thomas	Results of Evaluation of National Sample of Withheld Cards During APOC I
56	11/23/83	William Mockovak	Comparison of Data Obtained Using Alternative Questionnaires in the 1980 Census
57	08/17/83	Michael Mersch	1980 Decennial Census: Industry & Occupation Coding Postcoder Review Results
58	08/08/83	Pamela Ferrari Leroy Bailey	Preliminary Results of the 1980 Decennial Census Telephone Followup of Nonresponse Experiment
59	08/31/83	Janet Tippet Richard Takei	Evaluation of Reporting of Utility Costs for Selected Cities

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Assigned number	Date distributed	Prepared by	Subject
60	03/21/84	Janet St. Clair	Results on the Coding of the 1980 Supplementary Questionnaires for American Indians
61	10/28/83	Theresa J. DeMaio	Results of the 1980 Applied Behavior Analysis Survey of What People Do With Their Census Forms
62	10/14/83	Milton Fan John Thompson Henry Woltman	Final Summary of Results from the 1980 Census Empirical Variance Estimates Study
63	10/24/83	Kenneth Merritt	Summary of Quality Control Data Collected on Coding Edit and Followup Marks
64	n/a		
65	01/04/84	Kenneth Merritt	Experimental QC for Postal Updating Operations
66	11/28/83	Gordon Mikkelson Karen McKelvey	Preliminary Results From Administrative Records for the Update List/Leave Experiment Program Procedures Evaluation
67	09/30/83	Ellen Katzoff Robert Smith	Preliminary Results of the 1980 Content Reinterview Study
68	01/20/84	Michael Mersch	Results of Processing Center Coding Performance Evaluation
69	02/01/84	Kathryn Thomas Debbie Harner Robert Fay	Intraclass Correlations Using a Sample of 1980 Census Data
70	06/18/84	Leroy Bailey Pamela Ferrari	1980 Census Update List/Leave (ULL) Household Roster Check—Preliminary Report
71	02/14/84	Theresa J. Demaio	Results of the Applied Behavior Analysis Study (ABAS)/Census Match
72	03/21/84	Janet Tippet Richard Takei	Evaluation of Reporting of Utility Costs—Rockford, Illinois Supplement
73	05/09/84	Michael Mersch	1980 Decennial Census: General Coding—Income Items Factor-of-Ten Errors
74	04/02/84	Catherine E. Keeley	The Post-Enumeration Program Unresolved Cases Study Pretest
75	05/02/84	Patricia Berman Patricia Johnson	1980 Census: Preliminary Evaluation of the Sample Estimates for Race and American Indian Tribes
76	05/29/84	Gordon Mikkelson	Results of the Enumerator-Supplied Roster Portion of the Update List/Leave Procedures Evaluation
77	07/13/84	Kenneth Merritt	Analyses of Place-of-Work/Migration, Industry and Occupation, and General 1980 Census Coding Data
78	09/05/84	Patty Hartman	1980 Decennial Census: Qualification Tests for General Coding
79	07/05/84	Gordon Mikkelson	Results of the Postal Corrections Portion of the Update List/Leave Procedures Evaluation
80	07/05/84	Gordon Mikkelson	Evaluation of the Update List/Leave Corrections Operation

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Assigned number	Date distributed	Prepared by	Subject
81	07/27/84	George Sledge	Local Review Operation in the 1980 Census
82	07/30/84	Karen McKelvey	Results of the Failed-Edit Rates Portion of the Update List/Leave Procedures
83	08/01/84	Robert F. O'Brien	H4-Edit: Coverage Study
84	08/10/84	Marjorie Lueck Thomas Harahush George Sledge	The Prelist Recanvass and Local Review Coverage Improvement Operations
85	09/05/84	John Thompson	Preliminary Summary Results from the 1980 Census Coverage Improvement Program Evaluation
86	10/11/84	Karen McKelvey	Update List/Leave Experimental Program—Characteristics of Adds
87	09/14/84	Thomas Harahush	Evaluation of 1980 Decennial Census Casual Count Operation
88	09/14/84	Patty Hartman	1980 Decennial Census: Qualification Tests for Place-of Work/Migration Coding
89	09/24/84	Robert F. O'Brien	Whole Household Usual Home Elsewhere (WHUHE) Evaluation
90	10/11/84	Marjorie Lueck	Spanish Questionnaire Usage in the 1980 Decennial Census
91	09/26/84	Robert F. O'Brien	Relative Coverage in the 1980 Census of Puerto Rico
92	10/23/84	Milton Fan John Thompson	Evaluation of the 1980 Census Precanvass Coverage Improvement Operations
93	11/06/84	William Mockovak	Alternative Questionnaire Experiment
94	11/06/84	William Mockovak	Alternative Training Experiment
95	01/11/85	Paul Biemer	1980 Census Upper and Lower Bounds Study
96	11/28/84	Gordon Mikkelson	Results Concerning Update List/Leave Enumeration Procedures
97	12/10/84	Catherine E. Keeley	Derivation of Cost Estimates for Nonhousehold Sources and Vacant/Delete Followup Operations
98	01/07/85	Catherine E. Keeley John Thompson	The Nonhousehold Sources Program
99	03/07/85	Catherine E. Keeley	The Nonhousehold Sources Program
100	07/27/85	Janet Tippet Richard Takei	AHS [Annual Housing Survey]—Census Match Pretest
101	04/29/85	Kristin Hansen	Content Reinterview Survey—Analysis of Citizenship and Year of Immigration
102	05/02/85	Thomas Harahush Marjorie Lueck	Evaluation of 1980 Decennial Census Assistance Center Usage
103	05/02/85	Angela-Jo Wetzel	1980 Decennial Census: Testing of Item and Error Rate Data From the Coding Operations Against the Normal, Beta, and Gamma Distributions

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Assigned number	Date distributed	Prepared by	Subject
104	05/22/85	Robert Kominski	Evaluation of 1980 Decennial Census Education Questions
105	07/15/85	Theresa J. DeMaio	Compilation of What We Know About 1980 Census Data
106	06/19/85	Paul Bettin Cynthia Brown Philip Gbur	Results of the Census Geocode Error Study
107	07/16/85	Catherine Burt	Selection Aid Validation Study Summary Report
108	07/15/85	Kathryn Thomas	Census Unclassified Units by Race
109	08/05/85	Cynthia Brown	The Coverage of Housing in the 1980 Census
110	11/12/86	Edward Fernandez	Content Reinterview Survey: Spanish Origin
111	10/31/86	J. Gregory Robinson	Evaluation of Census Data on Place of Birth From the 1980 Content Reinterview Survey
112	2/24/88 REV 9/88	Jeffrey S. Passel J. Gregory Robinson	Methodology for Developing Estimates of Coverage in the 1980 Census Based on Demographic Analysis: Birth and Death Statistics, 1935-1980
113	2/25/88 REV 9/88	Jeffrey S. Passel J. Gregory Robinson	Methodology for Developing Estimates of Coverage in the 1980 Census Based on Demographic Analysis: Immigration Statistics (Legal)
114	12/31/87 REV 9/88	Jeffrey S. Passel J. Gregory Robinson	Methodology for Developing Estimates of Coverage in the 1980 Census Based on Demographic Analysis: Net Undocumented Immigration
115	7/30/87 REV 9/88	Jeffrey S. Passel J. Gregory Robinson	Methodology for Developing Estimates of Coverage in the 1980 Census Based on Demographic Analysis: Population Aged 45 to 64 in 1980
116	7/22/87 REV 9/88	Jeffrey S. Passel	Methodology for Developing Estimates of Coverage in the 1980 Census Based on Demographic Analysis: Population Aged 65 and Over in 1980
117	03/10/88	Robert Fay	Evaluation of Census Coverage from the 1980 Post Enumeration Program (PEP): Census Omissions as Measured by the P Sample
118	03/10/88	Robert Fay	Evaluation of Census Coverage from the 1980 Post Enumeration Program (PEP): Census Definitional Errors as Measured by the E Sample
119	03/10/88	Robert Fay	Evaluation of Census Coverage from the 1980 Post Enumeration Program(PEP): Census Duplications and Geocoding Errors as Measured by the E Sample
120	03/10/88	Robert Fay	Evaluation of Census Coverage from the 1980 Post Enumeration Program (PEP): P- and E-Sample Results by Type of Enumeration Area and by Mail Response
121	03/10/88	Robert Fay	Evaluation of Census Coverage from the 1980 Post Enumeration Program (PEP): Geographic Correlation Between P- and E- Sample Results
122	04/27/88	Paul Bettin	Evaluation of Census Coverage from the 1980 Post Enumeration Program (PEP): The Institutional Population

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Assigned number	Date distributed	Prepared by	Subject
123	03/10/88	Robert Fay	Evaluation of Census Coverage from the 1980 Post Enumeration Program (PEP): Missing Data in the P Sample
124	03/10/88	Robert Fay	Evaluation of Census Coverage from the 1980 Post Enumeration Program (PEP): The Effect of Moving on P Sample Completeness
125	03/18/88	Catherine E. Keeley Robert Fay	Evaluation of Census Coverage from the 1980 Post Enumeration Program (PEP): The Unresolved Cases Study
126	03/18/88	Robert Fay	Evaluation of Census Coverage from the 1980 Post Enumeration Program (PEP): Missing Data in the E Sample
127	03/11/88	Robert Fay	Evaluation of Census Coverage from the 1980 Post Enumeration Program (PEP): Evaluation of Post Office Responses on Definitional Correctness of Enumeration in the E Sample
128	03/10/88	Robert Fay	Evaluation of Census Coverage from the 1980 Post Enumeration Program (PEP): Evaluation of the Accuracy of Reported Census Day Address for Movers in the P Sample
129	09/07/88	Robert Fay	Evaluation of Census Coverage from the 1980 Post Enumeration Program (PEP): Rotation Group Bias in the P Sample: Possible Effects of Conditioning
130	9/15/88	Catherine E. Keeley	Evaluation of Census Coverage from the 1980 Post Enumeration Program(PEP): Procedural History